THE

ELECTRICAL REVIEW.

VOL. XCI. SEPTEMBER 29, 1922. No. 2,340.

ELECTRICAL REVIEW.

Vol. XCI.] CONTENTS: September 29th, 1922. [No. 2,340.

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"ELECTRICAL REVIEW" SUBSCRIPTION RATES.

UNITED KINGDOM	£1	14	8	per annum.
CANADA	1	12	6	do.
COLONIAL and FOREIGN ...	2	1	6	do.

Postage Free.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 6d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE, 4, LUDGATE HILL, LONDON, E.C. 4.

Telegraphic Address: "AGEEKAY, CENT., LONDON." Code, A B C.
Telephone Nos.: Central 8260 and 8261.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

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Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "London Joint City and Midland Bank, Newgate Street Branch."

TRAVELLING REPRESENTATIVES ABROAD.

AT a time like the present, when the volume of our export trade in general is considerably less than in the years preceding 1914, and when the competition in the world's markets of certain nations which experienced extensive industrial development during the years of war has become more severe, it is most essential that we should make the most strenuous efforts to recover our former position, and to strengthen it wherever possible. This is all the more necessary because certain former markets —Russia, for example—are either temporarily closed or their financial situation has been seriously strained through the effects of the war, or new Customs barriers have been or are being raised against other countries, including Great Britain.

A recent issue of the United States *Commerce Reports* contains a long article by the Director of the Bureau of Foreign and Domestic Commerce, dealing with the necessity for better salesmanship abroad and discussing the personal qualifications which are deemed to be indispensable for the advancement of United States trade with other countries. It is not our intention to deal with the many capabilities which are suggested as the requirements of American travelling representatives, but we may direct attention to one point in particular. This is the employment of naturalised Americans as foreign representatives of American firms. These men have proved to be unsatisfactory because although born in Europe and acquainted with the languages of their respective countries, their family connections and the personal and political antipathies involved in these connections were such as to prevent success in these particular countries. Similarly the engagement of men for the South American countries merely because of their knowledge of Spanish, while they lacked the requisite acquaintance with the goods they had to sell, has also (as might have been foretold) turned out to be a failure; and a similar observation likewise applies to American "hustlers" when sent from the United States to other countries.

The mention of the employment of non-native born travelling representatives has been made particularly for the purpose of referring to a statement which was published from a Lisbon correspondent by a leading German commercial newspaper on August 27th. The German writer there complains that great German industrial firms, owing to the apprehension that as former enemies of Portugal they would now be unpopular with the Portuguese, have entrusted their representation in Portugal to men of foreign nationality, either Portuguese or even Frenchmen and Englishmen. On the other hand, he asserts that certain English firms having a world-wide reputation, who were represented by Germans in Portugal in pre-war times, have now been glad to renew their relations with the latter as their representatives in Portugal. If this statement is correct, it is certainly worthy of investigation, for it is obvious that the needs of British manufacturers can only be best looked after by natives of these islands.

The problem in general is largely a question of markets and the selection of men most fitted to work them. According to the Board of Trade, we have already recovered a portion of the export trade to Argentina and Brazil that had been temporarily lost to the United States during the years of war; but there is still a lot of ground to cover before we wholly regain our former position in these two markets. Latin-Americans possess the remarkable characteristic of attaching importance to the social side of business, or rather to the social side apart from business. Every travelling representative of a foreign firm who wishes to promote the trade of his firm in Latin America has to learn to discuss matters of general interest with his prospective customers before touching the actual question of orders; he has to learn how moderately to entertain these Latin-American customers and to be polite and tactful; but any "hustling" tactics, as the North Americans have found out to their cost, are of no use in South America. So well do the Germans understand the Latin-American character that they have been known courteously to "hang on" to prospective customers for a year before being able to secure an order; but patience, politeness and determination have eventually won the day. Once a representative "gets in," future matters are plain sailing, provided that the representative is the same and has not been replaced by another man; and the competent representative never completely loses touch, as he always makes a friendly call when leaving the vicinity, and also sends a letter or card from a distance.

Under these circumstances it is necessary for the travelling representative to be fairly liberally supplied with funds both for travelling and for social purposes, in addition to a salary which will render him fully contented and stimulate his efforts not to be beaten by any competitor in the same line. Naturally the traveller must be acquainted with the language of the country as well as with the details of the manufactures which he desires to sell, and also be competent to arrange any modifications of manufacture in order to meet the particular requirements of customers without having to refer to the home office for information, save in exceptional cases. The works' trained man, with knowledge of the inside commercial experience of the firm, linguistic ability, and adequate remuneration, appears to be the best man for the position, provided that he possesses the other necessary qualifications.

If the expenditure to be incurred in properly endowing a travelling representative with the necessary facilities for the promotion of business in, say, South America should be beyond the capacity or wishes of firms individually, a way out of this difficulty lies in the constitution of non-competitive groups for sharing the expenses, a co-operative policy which has been advocated in these pages again and again, and one which has been tried by a number of groups in the electrical and engineering industry. As was mentioned in our issue of September 22nd, the F.B.I. has received a letter from Buenos Aires pointing out the desirability of securing joint representation in South America, where some of the largest British houses also act as agents for American goods, to the prejudice of British trade. The correspondent suggests the formation in Great Britain of non-competitive groups in the shape of limited companies, the capital being provided by the participating firms. This would permit of the establishment in South America of large and attractive showrooms and an adequate staff, and the goodwill of the business, which usually reverts to the agent, would be retained by the members of the company. In his opinion such a scheme would be more economical to work than the existing methods. Some previous experiments in this direction are said to have failed because of overlapping on the one hand, and because on the other they did not cover a sufficiently wide field.

Although the days of individual private enterprise are by no means past, there is much to be said in favour of the extension of the system of joint representation in foreign countries. Unless development in this direction takes place now that the conditions of the world have undergone such a remarkable change in recent years, it is to be feared that individual firms in working foreign markets may be unable in the long run successfully to withstand the strength and activity of our greatest competitors—the great corporations and trusts in the United States—while Germany, owing to the depreciation of the mark and the consequent enhanced cost and difficulties of obtaining certain raw materials, looks like gradually losing her power of offering successful rivalry in the markets of the world.

Two Points in the Labour Problem.

Sir Lynden Macassey, than whom we have amongst us few more experienced authorities on trade disputes, has been addressing a conference of works managers, directors, foremen, and forewomen at Balliol College, Oxford. He dissected the Labour problem, and, after disposing of the extremists' suggestions for eradicating the capitalist from industry and showing the failure of syndicalists wherever they had tried to control industry in their own interests, turned attention toward serious proposals for reform.

Sir Lnyden does not anticipate the approach of industrial peace until the unemployment question has been settled, and he holds that the worker has got to be assured also that he is getting a fair share of the products of the industry with which he is connected. The problem of unemployment is older than most of us, and many propositions have been advanced to deal with it—with what result? To-day, as winter approaches, we have unemployment on a deplorable scale, and more works have been lately closing down. If unemployment is a cause of industrial unrest, as we believe it is, it is certainly also the fact that the absence of industrial peace has been the cause of a great deal of the unemployment of the past year or so. We too readily get into the way of looking to the Government to give us a lead in dealing with such problems, and when it was announced a few weeks ago that the Cabinet was considering the question of unemployment and the means for its mitigation during the approaching winter, some may have imagined that the Prime Minister would be able to make a speech which would raise the hopes of the community. But this is too tough a problem to be dealt with hastily while so many things in the international economic situation are unsettled. Indeed the probability is that we should stand a better chance of finding a practical solution if we looked less to the Government and more to ourselves, for business is not revived by Governments however valuable may be the measures of encouragement that they have it in their power to give.

During the past few years leading authorities have advocated the idea of each industry carrying its own unemployed, but we suppose it is not possible to make headway even with that idea until our industries are able to get on to economic production and to carry the burdens that are already strapped about them or to cut the bands thereof. Sir Lynden Macassey supports the legitimate claim of the workers to have a fair share of the products of industry, but unfortunately just now many businesses are fearing that they will have little or no products (profits we presume) to show from the current year's operations because of the slackness of trade due to recent industrial disputations, the international situation, and other causes. It looks very much as though the two points that we have selected from Sir Lynden's dissection of the labour problem are unlikely to be effectively dealt with until we all concentrate on the revival of trade at home and abroad.

The events of the past few weeks in the Near East have temporarily deferred the return of confidence and stability, and have hindered trade revival there; probably other menacing points will arise which must be cleared up before this poor old world will be at rest, but there is much ground for hope for electrical trade revival, and pessimism is unjustifiable here at any rate; possibly the settlement of the Straits question will help to bring order out of chaos elsewhere.

A third point mentioned by Sir Lynden was the conferring upon the worker of a human status—giving him a voice in determining his condition; but in respect of all three points, nothing would be done until they had a real educational campaign—a campaign in economics for both employers and employed.

Insulating Materials.

In the early days of electrical "engineering," when the most advanced practitioners were but experimental amateurs, the insulating materials employed were of simple character, consisting largely of glass, sulphur, and shellac for electrostatic apparatus, and of cotton or linen tape, silk, shellac, and varnished wood for appliances operating at lower pressures. Wonderful results were achieved with these elementary means, but the insulating material, then as now, was always the weakest factor in the structure of electrical devices, and was the subject of many gibes on the part of mechanical engineers, accustomed as they were to the handling of steel and brass, and contemptuous of textiles and resins. The introduction of rubber and ebonite, vulcanised fibre, and mica wrought great changes in electrical practice, porcelain took the place of glass, and oil, paper, bituminous compounds, and formaldehydes have found most valuable applications; yet the fact remains that the physical properties of the available insulating materials leave much to be desired. Prof. Miles Walker states that "all the good insulators are mechanically weak in some respects." Those that best withstand compression lack ductility, and all insulating substances are weak in tension, compared with other structural materials. Textile fabrics impregnated with varnishes "form the most flexible insulators known, but their flexibility is destroyed when the material becomes dry," and consequently they cannot be used at a temperature of or exceeding 100 deg. C., so that a rigid limit is imposed upon the load that a machine can carry continuously with safety.

Insulating material then is still the controlling factor in the design of electrical apparatus. It is true that the practical working pressure attainable has been gradually raised to more than 200,000 volts, and far higher pressures can be reached, by increasing the dimensions of the insulating material employed—but the temperature limit is inexorable; were this removed, or even raised to 200 degrees, the cost of electrical apparatus could be greatly reduced. Even in the case of d.c. generators and motors, this holds good, for the commutation limit is a matter not of material so much as of design, and has been raised to a degree which leaves the temperature limit the dominant factor.

When we reflect that with air at 25 deg. C. the permissible temperature rise is only 65 degrees with a reasonable margin of safety, and that if the temperature limit were raised to 200 degrees, the permissible rise would be 175 degrees, the importance of the question will be evident. The efficiency of a machine would as a rule be lower at the higher temperature, but in these days of high capital charges, high output per lb. is of far greater importance than high efficiency.

In view of these considerations, the close attention which is being given to research on insulating materials is clearly justified. The work is mainly directed at present to the properties of insulating materials which are suitable only for temperatures below 100 degrees C., and several articles on this subject have appeared in our columns in recent months, as well as communications emanating from the British Electrical and Allied Industries Research Association; the immediate aim of the Association appears to be to place the methods of investigation on a firm basis, enabling true comparisons to be drawn between the results of different experimenters. In November last year we published the results of an investigation carried out by the Research Association on the best form of spark gap to determine the dielectric strength of insulating oils; and in the *Journal* of the Institution of Electrical Engineers last issued suggestions are made by the Association for the adoption of standard methods for determining the electric strength of fibrous insulating materials, with a view to placing the subject on a sound basis and producing comparable results. These directions, which have been arrived at after careful consideration of the various methods previously used, should be very helpful to research workers, and at the same time, if generally adopted, undoubtedly will very greatly increase the value of the results obtained.

Smoke Abatement.

In the forthcoming session, the Smoke Abatement Bill will reach the report stage in the House of Lords. In the meantime it behoves those who are dissatisfied with the measure to consider how they wish the Bill to be altered. Lord Onslow, as Parliamentary Secretary to the Ministry of Health, speaking on the Bill on the second reading in July, suggested this postponement so that the considered opinion of all those interested in the matter might be ascertained by private consultation.

The electricity supply industry will probably have something to say on the matter, since, as the law stands at present, smoke, to be a nuisance, must be *black* smoke, whereas the new Bill rules that *any* smoke may be a nuisance, and furthermore includes under the term "smoke" soot, ash, or gritty particles. Moreover, it makes the penalties very much stiffer; and if a local authority does not take the matter up, the County Council can do so over its head.

But the chief defect of the measure seems to lie in the lack of definition. The Smoke Abatement Committee's report, on which the Bill is based, recommended that the Ministry should *fix standards* with regard to smoke, but the Earl of Onslow said that there was great difficulty in carrying this resolution into effect. He did not at present see any practical method of doing so. Possibly he was not acquainted with Ringelmann's smoke charts, which enable the density of smoke to be estimated with a reasonable degree of accuracy. As regards culpability for smoke nuisance, generally speaking the electricity supply industry does not seem to be a very great defaulter—at any rate in the London area. Last year, for instance, the Public Control Committee of the L.C.C. stated that there were no fewer than 42 electric generating stations in the County of London, and that in recent months serious smoke nuisance had only been observed in four instances, all municipal. The Report went on to say that in the other 38 cases the nuisance had either been occasional or non-existent. The London companies are to be congratulated on a further remark in the Report, which pointed out that it was significant that there was not "a single case of serious smoke nuisance from power stations belonging to any of the electricity companies." But that was under the present Act—whether all these company undertakings would remain as impeccable when tested by the severer conditions of the new Bill, remains to be seen.

The Bill, however, contains one section which may be actually in favour of electricity supply undertakings, namely, the one by which urban authorities are empowered to make by-laws requiring that in any new buildings (other than dwelling-houses) the arrangements for heating shall be such as are calculated to prevent or reduce the emission of smoke. Electric heating may here come into its own. The Bill should certainly receive the early consideration of any undertakers who think that the measure in its present shape is likely to bear hardly on the industry. But in offering opposition to the Bill, the undertakings must not forget that one of their own slogans is "no smoke, no smell, no fumes," and that "smoke abatement" in principle is one of the things they are themselves out for in their propaganda.

D

NORTH-EASTERN RAILWAY ELECTRIFICATION.

A Main-Line Express Passenger Locomotive.

The first high-speed passenger locomotive designed for service on a British trunk-line railway has recently been completed, and is now in experimental service on the Newport-Shildon branch of the North-Eastern Railway.

This locomotive, which is the one referred to by Sir Vincent L. Raven, K.B.E., in his paper before the N.E. Coast Institution of Engineers and Shipbuilders,* has been designed for hauling express passenger trains over the main line of the North-Eastern Railway between Newcastle and York; the mechanical parts of the locomotive were designed by the North-Eastern Railway Co.

Fig. 1.—Locomotive Hauling a Train.

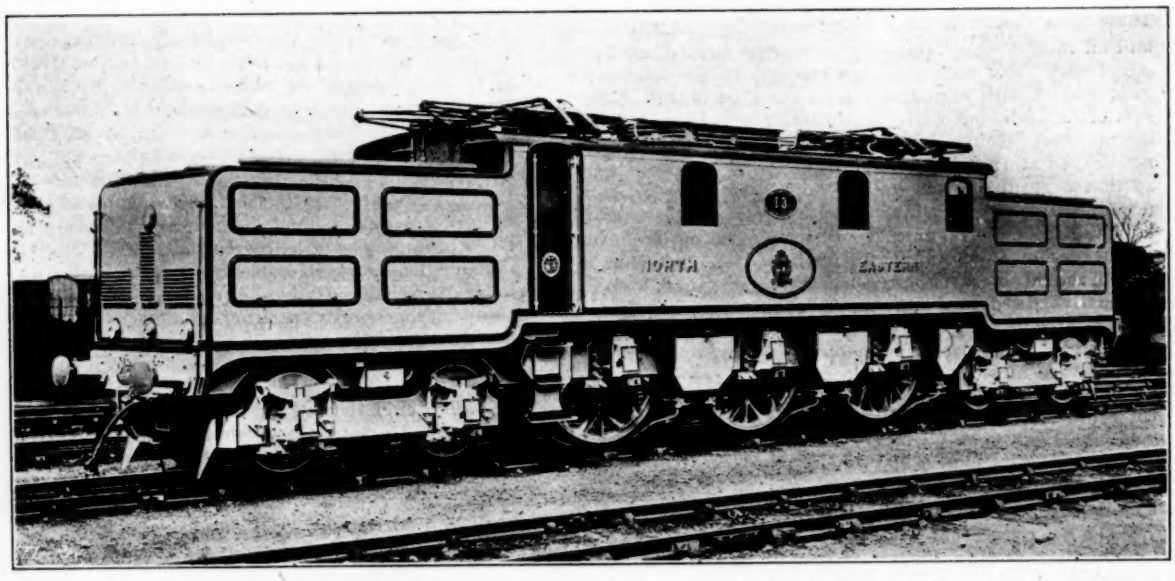

Fig. 2.—Main-line Express Passenger Electric Locomotive.

and constructed at its locomotive works in Darlington, and the electrical equipment was designed and manufactured by the Metropolitan-Vickers Electrical Co., Ltd., at its works at Trafford Park, Manchester.

The locomotive is capable of hauling 14 of the East Coast Joint-Stock main-line coaches, weighing 450 tons, between Newcastle and York, a distance of 80.3 miles, in 90 minutes, and performing the journey in the reverse direction in 95 minutes; on straight level track it is capable of hauling a similar train at a speed of 65 miles per hour. All mechanical parts of the locomotive and also the motors and gearing are so designed that the limits of safety will not be exceeded when the locomotive is running at 90 miles per hour.

The locomotive, which is of the 4-6-4 type, consists of a plate underframe carried on three pairs of main driving wheels of 80 in. diameter, and supported at each end by a four-wheel locomotive-type bogie.

The main motors are bolted solidly to the cross members of the main frame, and transmit their torque to a hollow shaft or quill which surrounds the main running axle, this hollow shaft being journalled in special axle bearings on the motor frame. The torque is transmitted from the hollow shaft to the driving wheels by a system of helical springs attached at their respective ends to the arms of the quill and the brackets which are attached to the driving wheels.

With this arrangement of drive, the dead non-resiliently-supported weight on the driving wheels is reduced to a minimum, as, with the exception of the main driving wheels, the only non-spring-borne weight is that of the main axles, axle boxes, and spring brackets.

The locomotive is designed to obtain its current supply either from an overhead trolley line or from a third rail, at 1,500 volts. Current is collected by means of two pantograph trolleys or four collector shoes.

The main motors are of the twin-armature type, each armature being fitted with a pinion which meshes in a common gear wheel, mounted on the hollow shaft or quill which surrounds the driving axle. Each twin motor is rated at 600 h.p. at the one-hour rating, and 400 h.p. continuously; thus the locomotive is capable of exerting 1,800 h.p. at the one-hour, and 1,200 h.p. at the continuous rating. The tractive efforts corresponding to the hourly and continuous ratings are 15,900 lb. and 9,480 lb. respectively.

With a view to obtaining as flexible a locomotive as possible, arrangements have been made whereby current

* Electrical Review, Dec. 30th, 1921, and Jan. 6th, 1922.

can be diverted from the main motor fields by means of reactive shunts, and this arrangement, in conjunction with the varied motor groupings, gives 12 economical operating speeds.

The control system is electro-pneumatic, the motor current being handled by electro-pneumatic line switches, contactors, and cam-type switches. The cam switches are used for reversing, for motor combinations, and for field shunting, and the line switches and contactor switches for handling the main current and as resistor switches.

All these switches are operated by means of air pressure at 70 lb., the air valves being operated by means of small magnets actuated by current at 50 volts, which is obtained from a small auxiliary battery. The air for operating the switch is obtained from the main air compressor, which supplies air for the Westinghouse brake, whistles, and sanding gear, through the medium of a reducing valve.

Each switch is a complete unit in itself, with its own blow-out coil, arc chutes, operating air cylinder, and magnet valve, and the switches are arranged in groups on either side of the high-pressure compartment in such a way that any one switch may be removed without disturbing adjacent switches in a group.

Inspection of the arc chutes, contacts, and control interlocks can be done from the front. All the main circuit connections are made from the back.

The control of the motors by means of the contactors and other apparatus is effected by the master controllers through an auxiliary circuit which energises the small magnet valve of the various contactors and cam switches. One master controller is placed at each end of the central compartment of the locomotive, so that the locomotive can be run equally well in either direction. The running positions are clearly marked on the controllers, and each set is indicated on a notch plate.

There are two operating levers, an accelerating lever and a combined motor combination and reverse lever.

The following auxiliary machinery is installed in the locomotive:—

Motor-driven air compressor.
Motor-driven intermittent exhauster.
Combined motor-generator and continuous exhauster set.
Motor-driven blower set.
Auxiliary battery.
Electro-steam boiler.

The compressor, which is of the two-cylinder geared type, supplies air for the "Westinghouse" air brake, whistles, and sanding gear at 100 lb., and, as previously stated, air for the control system through the medium of a reducing valve.

In order that the locomotive may be able to operate trains fitted with the vacuum-brake system, two rotary exhausters have been installed.

The continuous exhauster, which corresponds to the small ejector on a steam locomotive, is coupled to the motor-generator set which provides l.p. current for charging the auxiliary battery and the control system. The exhauster itself is so arranged that it can be disconnected from the motor-generator set when the locomotive is operating trains fitted with the "Westinghouse" air brake.

The intermittent exhauster, which corresponds to the large ejector in a steam locomotive, is used for releasing the brakes after an application, and is automatically started up as soon as the driver's brake valve is placed in the "release" position.

The motor-driven blower set provides air for ventilating the main motors and the reactive shunts.

The boiler, which is used for supplying steam for heating the passenger coaches, is of the fire-tube type, each tube containing a heating element consisting of a tube of quartz, in the interior of which is a spiral of high-resistance wire. The boiler contains in all 144 of these elements, and switchgear is provided so that the number of elements in circuit can be reduced as desired when the full output is not required from the boiler.

The particulars and leading dimensions of the locomotive are as follows:—

Weight in working order ...	about 102 tons.
,, of mechanical portion	,, 72 ,,
,, of electrical portion	,, 30 ,,
,, on driving wheels ...	,, 18 tons 10 cwt.
,, on bogie wheels ...	,, 11 tons 12½ cwt.
Type of locomotive	4-6-4.
Motor equipment	Three 600-h.p. twin motors.
Control equipment	Electro-pneumatic.
Traction system	1,500 volts supply to overhead line or collector rails.
Current collectors	Pantograph trolley and collector shoes.
Brakes	Dual fitted (Westinghouse and vacuum).
Length over buffers ...	53 ft. 6 in.
Length over body	49 ft. 8 in
Distance between bogie centres	37 ft. 2 in.
Distance between driving-wheel centres	8 ft.
Rigid wheel base	16 ft.
Bogie wheel base	6 ft. 6 in.
Total wheel base	43 ft. 8 in.
Diameter of driving wheels	6 ft. 8 in.
Diameter of bogie wheel ...	3 ft. 7¼ in.
Gear ratio	24 : 85.
Centre of gravity	about 5 ft.

LOCAL CO-OPERATION.

By H. R. TAUNTON.

The small electrical contractor—too often a man of narrow outlook—is so jealous of his petty independence that the bare suggestion of co-operation with his local competitors makes him snort. Without wasting time in thinking it over, he dismisses the idea with a few terse expressions of suspicion, ridicule, and irritation.

The basis of his distrust is that any scheme which might benefit him must also benefit his competitors. He would rather sink with them than that they should swim with him. If he happens to want an odd lampholder, he would rather write up to London, and pay the carriage on it, than buy it off his fellow tradesman round the corner, lest he put a penny profit in the latter's pocket.

So half a dozen small men in a radius of a quarter of a mile struggle on, each equipping an unsatisfactory showroom, each stocking the same articles, bought in small quantities at heavy carriage charges and unfavourable discounts, each with his staff and labour troubles, his ineffective advertising schemes, his disproportionate standing charges; all of them struggling tooth and nail to get what work is going, or at worst, to prevent the other fellow getting it. In their absurd jealousy they quote prices which they know must mean a loss to them if they are to do honest work. If they don't get the job, they console themselves with the reflection that the other's success is another nail in his financial coffin. If they do get it, they are driven, all too often, lest it should be a nail in their own coffin, to cut the quality of their material and labour.

The public, though at first sight they may appear to benefit by competitive prices, suffer in the result from shoddy work. The industry suffers: directly by diminished turnover of good wiring material and reduced employment of skilled labour; and indirectly by the bad reputation which follows bad installation work, and clings to electricity and all its applications. And

finally, the contractors themselves suffer—sooner or later, they share the fate of the Kilkenny cats.

It is often argued that competition is a salutary rule of nature. The fiercer the better—elimination of the unfit—survival of the fittest. If the unfit would only eliminate themselves quietly, and be done with it, the argument might pass. Unfortunately their bad deeds live after them, even if they themselves do not come to life again in another name and another district. And besides, for every one unfit eliminated, two more spring up to take his place.

The law of the survival of the fittest, which means too often that of the most unscrupulous, has long since been rejected in the social order. It is equally an anachronism in commercial life. Far better for trade, for six small men to combine, more or less completely, into one strong whole and continue in active business, than for five of them to perish singly, and leave the sixth man crippled.

Small contractors, with limited capital, cannot hope individually to compete with the attractions of supply authorities' showrooms, run without regard for profit and loss, at the expense of the ratepayers. Nor will they be able to compete with the new multiple-shop syndicate which, so rumour has it, proposes to open showrooms throughout the kingdom for the sale of electrical appliances.

Contractors are threatened with the loss of one of the principal mainstays of their business—their cash sales. Their only hope of withstanding the onslaught of these moneyed competitors lies in intelligent co-operation. Some months ago a writer in the Review made the same suggestion; but the co-operation he proposed was of too wide and comprehensive a nature: practically amalgamation of all the local contractors for all business purposes. It left no scope for individuality, for reasonable competition, or for the independence so dear to the small business man. The only co-operation that has any chance of appeal or of success (at least as a beginning) is in respect of showrooms and stock. If a co-operative scheme embracing these two factors were adopted and worked harmoniously, possibly other developments might follow: interchange of skilled labour, for instance; or combined advertising; or even some tentative schedule of minimum prices for standard work.

For the present, however, it will be more practical to consider simply a broad scheme of co-operation between local contractors, of which the two main articles would be a joint showroom and a common stock.

Take the showroom first. Every contractor aspires to a showroom of some description. Often enough most of the show is in the window. For the rest, a small, badly-lit shop, overcrowded with cheap and ill-assorted fittings, and dusty shades; a fan, a kettle or so; a litter of bell materials and small accessories; a motor, perhaps, or other plant "on sale or return": all against a background of gaudy posters. No originality, no taste, no method. No "note" is struck—there is nothing to attract the passer-by, or to hold him if he happens to come in.

Often the fault is lack of taste and discrimination: more often, simply lack of capital. A good showroom—one which will bring good business—is expensive to equip and maintain. It must be commodious, well planned, and artistically decorated and furnished; it must be equipped with a wide selection of fittings, some of them costly, to appeal to a variety of tastes; it must offer a complete range of electrical domestic devices and novelties; it needs a trained salesman or saleswoman, with one or more assistants; it has to be kept brilliantly lighted, and clean, and fresh, and up-to-date.

The average contractor simply cannot afford the initial expense, or even the maintenance. He has to be content to see potential customers going to the Corporation showrooms, or to those of the wholesale suppliers, or even of some large furniture dealer or decorator, and there spending their money freely on articles which carry vastly more and easier profit than does competitive wiring: money which would make all the difference, to him, between a shaky and a sound business, could he but attract it to his own doors. Of course, he realises the value of an attractive showroom. His trouble is that he also realises that he cannot afford one. But he could afford, say, the sixth part of one: initial cost and maintenance.

There is nothing but prejudice and jealous suspicion to prevent him and, say, five of his fellows, combining together to rent a suitable shop in a good thoroughfare—not in immediate proximity to the premises of any one of them—and putting up the capital, or contributing from their existing stocks, to equip it.

Clearly the simplest instrument of association would be a small limited company, in which the contractors would be shareholders and active directors. If they were of pretty equal standing, they would put up equal shares of the initial cost. If one of them were in a fairly big way of business, or two or three of them in a very small way, their initial shares of the costs, and the profits, would vary accordingly.

A certain reserve of capital would be necessary in the early days to meet standing charges, salaries, and maintenance costs. The staff required would be small; and, of course, it would have to be specially engaged, and be quite independent of the existing organisations of the firms concerned. An expert salesman who would act as manager, responsible to the co-operators; one or more assistants, perhaps, according to the size of the showroom; and a handyman or boy. All book-keeping and correspondence would be conducted on the spot (one of the assistants could do what little clerical work were needed) and not in the office of any one of the firms—that would open the door to suspicion and intrigue. All books and files, needless to say, would be open to any of the members at any time.

Once started, such a showroom would not only pay for itself, but would yield profits considerably in excess of the aggregate profits the firms concerned could hope to derive from the sale of fittings and accessories in their own small shops. It would be in a position to compete with anything likely to come up against it: corporation, wholesale house, or syndicate. Its very existence in a good shopping centre would be a great advertisement for the co-operating contractors; and its attractive window display would stimulate a demand among shoppers for electrical gear, undreamt of in the side streets in which contractors usually languish.

The financial results of the venture would be divided among the members; first, according to their direct introductions, secondly, according to their initial shares. Each member would have a book of numbered tickets, in duplicate, bearing his name, and a space for the name of the customer he introduces. He would hand in his ticket when he brought his man round; or give it him to hand in. All invoices made out for purchases by such customers would be entered accordingly to the credit of the introducer. At the end of the quarter, or whenever it might be found convenient to pay a "dividend"—probably more often than in the case of an ordinary limited company—the total sales would be divided into two headings: (*a*) sales made to introduced customers; (*b*) sales made to casual purchasers. The first figure would be subdivided into the amounts of the sales credited to each of the members, easily ascertained and checked by the tickets and their duplicates. To these varying amounts would be added the share of the second figure to which each member would be entitled according to his holding. The profits would then be divided in proportion to the final amounts so arrived at.

To take a simple example. A puts up three-tenths, B and C two-tenths each, D, E, and F one-tenth each of the original outlay. The total sales in three months are, say, £2,000. A is directly responsible for £500 of this, B for £300, C for £200, and unlucky D, E, and F have not been able to introduce any customers at all. The remaining £1,000 of sales represents casual purchases. The profits would be divided, therefore, as follows:—A, 40 per cent. (representing a total of £500, plus £300, three-tenths of the casual purchases); B, 25

per cent.; C, 20 per cent.; D, E, and F, 5 per cent. each.

Thus, A, B, and C would get the proportionately larger share due to them for their success in introducing customers, just as they would have done if they had sold from their own shops; while D, E, and F, who were unable to introduce any business, still get a return on their original investment—probably more than they would have got under similar unfavourable circumstances if they had kept their share of the co-operative capital in their own not very flourishing concerns.

All six members, too, will have saved a large proportion of their outlay in reduced rent, salaries, and other standing charges of their own businesses, owing to their not having to maintain a showroom, or an apology for one, or to handle fittings and appliances. Or, at the worst, they will have other compensating advantages, such as increased office accommodation, and less congestion of clerical work.

So much for the joint showroom. If it be admitted that that is possible, the keeping of a common stock is a simple corollary.

Stock—overgrown stock—dead capital continuously depreciating—has ruined more contractors, big and little, than any other factor. The only safe policy where stock is concerned is: as small as possible, and moving as quickly as possible, so that no item appears in two consecutive stock lists. That is an ideal that is comparatively easy of attainment by co-operation.

The premises taken for the joint showroom should have a basement, or other annexe, which would form a store for wiring material and accessories. The only other extra initial cost will be the fitting of the usual bins and shelving. The only extra running cost will be the wages of a store-keeper, with any assistance that may be found needful, according to the volume of the stock. He would be under the control of the showroom manager, and would, of course, have to be a thoroughly reliable and independent man.

Here would be kept a stock of all the ordinary wiring material and accessories wanted for contract or jobbing work: conduit, cables, switches, lamps, and so on; and on this common stock each of the co-operators would draw as he required it. Suitable requisition forms would be used, duplicate copies being handed to the storekeeper. One of these would be returned to the contractor after issue of the goods, priced at cost; and the other, similarly priced, would be filed for record. Definite rules would be laid down for payment; no member, for instance, would be given credit beyond the amount of his share in the company.

On paper the stores would naturally show a loss, as goods would be passed to members at net cost, leaving the standing charges still to be met. These—consisting of storekeeper's wages and an agreed proportion of the rent and so on of the whole premises—would be divided among members in proportion to the total amounts of their requisitions. If A, for instance, in a given period, took a third of the total goods issued, and B only a quarter, they would pay a third and a quarter of the overhead charges respectively, either in cash or as a debit against their share of the showroom profits.

Alternatively, an agreed definite percentage might be added to each invoice, estimated to cover amply the percentage of overhead charges; any surplus, when accounts were balanced, being divided as before.

Whatever the amount each member had to pay to meet his share of the overhead charges of the stores, it would certainly be less than it would have cost him to run his own store. This is obvious from the fact that the six (in our example) separate stores, each involving expense in rent, lighting, wages, &c., would be replaced by one common store, the overhead charges of which would be little more than those of any one of the six.

The saving of expense, however, is a minor advantage. Even if each member had to pay as much for the common store as for his own, this would be more than compensated for by the great economies effected both in volume and cost of stock.

A large proportion of every contractor's stock is surplus to his actual requirements. A certain surplus is unavoidable; but it is generally much larger than it need be. If our six contractors had their stock in common, the surplus on the combined stock need not be any larger than it would be on any one of the individual stocks. The aggregate volume, therefore, would be reduced by the amount of about five surpluses.

One of the causes of a surplus stock is that a contractor, to secure discounts, buys in dozens or grosses, when he only wants units or dozens. Six contractors together, however, would quickly get through the dozen or gross lots. They would be ordering, therefore, little in excess of their immediate requirements.

As a matter of obvious fact, supplies would be ordered from makers in much larger quantities than any one member could order. This would mean greatly improved discounts and rebates. Take E.L.M.A. lamps as an example. Probably each member, singly, would be only graded near the bottom of the lower scale. Buying together, in the name of their co-operative company, they would almost certainly qualify for a grading in the higher scale, and so save something like 10 per cent. on every lamp. Or take cable. Each member may be buying from a different C.M.A. maker, and hardly qualifying for the minimum rebate. Buying together, their turnover and consequent rebate would be considerable.

In short, each of the six small contractors would be buying his material, through the co-operative company, on the same terms as the largest contractors in the trade, who, by reason of their large annual turnover, enjoy preferential terms of anything between 5 per cent. and 10 per cent., or little short of factors' terms.

Indeed, it is arguable that such a co-operative company could legitimately claim to be classed as factors, and to be entitled to terms accordingly. The company itself would not be a contracting firm, and would be buying only for resale to the trade—the contractor-members.

For the matter of that, there is no reason why they should not sell to the trade: the little firms, and the jobbing wiremen, who would not be members of the company; and to whom they could afford to sell at ordinary trade prices, so realising a certain profit towards their standing charges.

The great point is that stock would always be moving, keeping it up to date, and reducing the chances of loss by makers' price reductions and normal wastage. There are other minor advantages of one common stock instead of a number of separate ones, such as saving in carriage, reduction of labour in packing, and simplification of the "empties" problem.

The principle might be extended to the holding of a common stock of heavy tools and plant, such as stocks and dies, ladders, and the like, which could be hired by members at nominal rates. Six independent contractors, for instance, would each have an expensive testing set, which, on an average, they would only use, at most, a couple of days a week. Working together, they would only need one or two sets, effecting a saving of at least four. If there were more than six members (that number has been taken throughout only for the sake of a convenient example) the saving would be so much the greater. There is no reason why twenty contractors should not join together—the more the merrier, and the greater, obviously, the results.

One could continue to fill columns dilating on the advantages of co-operation between contractors, even if confined to showrooms and stock. Enough has been said, if not to convince, at least to afford food for thought and discussion. It is difficult to see any tangible reason why some such scheme of local co-operation should not be successfully inaugurated in every considerable centre.

Except, alas, the one reason given in the opening paragraph of this article!

THE STATUS OF ELECTRICAL CONTRACTORS.

By H. MARRYAT (President of the Electrical Contractors' Association, Inc)

My Association is grateful to the Electrical Review for the part you took in its formation and your interest in its welfare ever since. Your editorial comment and criticism has been well-informed and always welcome. It is therefore with the greater regret that we read the article by H. R. Taunton in your current issue, which is likely to do injury to electrical contractors generally and to this Association in particular.

Unfortunately the prominence of this article renders it difficult to reply adequately in your "Correspondence" column, and it is desirable that you should review the subject again in a manner calculated, so far as possible, to counteract the damage done. To this end I shall be pleased to place the facts at your disposal and to substantiate them from the records at the Association's office.

Mr. Taunton's object is apparently to help the Association: it is regrettable, therefore, that he did not seek information here before writing. If he will do so now he will appreciate the humour and the offence his contentions have aroused. Every one of his 32 paragraphs is misleading.

Admittedly this section of the industry is not so strong financially as others; but this arises out of difficulties which we are steadily overcoming. Apart from this I say as a business man of no small experience that the organisation, management and discipline of the Electrical Contractors' Association compares not unfavourably with that of any other section of the industry.

It is not necessary in this communication to deal with the mis-statements which permeate the whole of the four-column article: they are founded on four fundamental errors.

1. That the Association is not fully representative. Your writer says: "there are a number of firms of standing who have hitherto not considered it worth while joining the Association." And again: "There are many firms of repute who at present refuse to become members."

Will Mr. Taunton give me a list of these, as I am most anxious to find them? A special committee is now making great efforts to get into touch with the remaining outstanding firms, but at present we do not know their names. In October a special issue of the *Electrical Contractor* will have the same object in view. By a comparison with manufacturers' and wholesalers' mailing lists it appears that the E.C.A. represents 90 per cent. of the buying power of genuine electrical contractors.

2. That our membership is not sound. "There are a number of members of the Association who are not firms of good standing (at least, as electrical contractors), whose only qualification is the ability to pay their subscriptions."

I defy Mr. Taunton to mention one.

There are many references to "shoddy" and "dud" firms members of the E.C.A. The reply is that there is none such, and if one is discovered the Council will have a very brief way of dealing with the case. If Mr. Taunton cannot make good these aspersions he should apologise.

3. That entrance to the Association is unguarded. "For every 'dud' firm struck off the list three or four firms of repute would hasten to join. Nobody values membership of an organisation which admits any Tom, Dick, or Harry who will pay his fee."

Mr. Taunton lays down qualifications which he thinks should be required of members. The absurdity of all this is that the Association requires qualifications more far-reaching than your writer suggests, and every application must be accompanied by references which are sifted with the utmost care, so that it usually requires several months to complete the election of a new member. Certainly no capital qualification is required, as we encourage the qualified small man, but we do require a reputation for honest straightforward dealing, good work, and evidence of technical training.

4. That members do jerry work, use poor material, and cut wages. He says: "All members should employ labour on the terms agreed with the E.T.U."

Is Mr. Taunton not aware that this is a condition of membership of the N.F.E.A., which is the branch of the E.C.A. organisation dealing with labour matters?

One of the most amusing (to us) errors which Mr. Taunton falls into is the suggestion that the E.C.A. might enforce a minimum standard of wiring if they could count upon the supply authorities to report infractions. Why, it is the supply authorities who object to the introduction of the minimum standard. They fear it will increase the cost of wiring. The whole of my membership earnestly desires this reform, and I challenge anyone to show that the work of my members is not of an average higher than that set by supply authorities.

A REPLY BY THE AUTHOR.

Mr. Marryat apparently construes my article as an attack on the E.C.A. I am sorry, for nothing was further from my thoughts. Any allusions in it to the Association were by way of friendly criticism. If I have failed to give due meed of admiration to its scheme of voluntary registration—and that, reading between the lines, is, I think, the kernel of my offence—I am surely entitled to express a personal opinion without being called upon to "apologise" because it does not coincide with that of the Committee.

Mr. Marryat sweepingly dubs all my "32 paragraphs" as misleading; but mercifully he only particularises four points, and with these I will try to deal.

1. He objects to my statement that there are "a number of firms of standing" or "many firms of repute" who are not members of the E.C.A., but in his next paragraph he practically admits the same thing, giving my indefinite quantities, "a number," "many," the definite value of "10 per cent. of the buying power of the trade." Not to quibble about words, however, it is evident the essential difference between us is that he considers the membership figures of the E.C.A. satisfactory, and I venture to think the opposite.

According to the "Year Book," there were in May last 672 full members. On Mr. Marryat's figures, therefore, there are only about 750 contracting firms of repute in the Kingdom! Or to take a concrete example: in East Anglia (the counties of Norfolk and Suffolk) there are only, I believe, two contracting firms which are members of the E.C.A. Does Mr. Marryat suggest that these represent 90 per cent. of the buying power of the trade in that extensive area, or anything like it?

2. Mr. Marryat can scarcely expect me to put my hand in the fire by citing any one member of the E.C.A. as a "shoddy" firm. If he really lacks information on the point, he can get all he wants in the frankness of the after-dinner hour, in the smoking room of the Engineers' Club.

Moreover, he ignores the fact that, in speaking of these firms, I emphasised the point that they are mostly of the "side-line" class—firms which may be of the highest standing as drapers, plumbers, and so on, but whose nondescript electrical department certainly does not qualify them to be considered genuine electrical contractors, and should not qualify them to be members of the E.C.A.

3. What are the far-reaching qualifications which Mr. Marryat says the Association requires of its members? I take his word for their existence, but why are they not printed in the "Year Book," for the guidance of intending, and of existing, members? One suspects—I suggest it with all diffidence—that they are rather in the nature of pious aspirations, than hard and fast rules. I have been intimately associated with the industry since 1898, and I have never heard of them. I have to-day looked through a voluminous file of correspondence with the E.C.A. and found no allusion to them. And all I can see in the "Year Book," remotely referring to them, is on page 147, where it is stated that, under the terms of the B.O.T. licence, the Association is debarred from "imposing any restrictions on its members"!

As to the references of which Mr. Marryat makes a point, they, like all references, may mean much or little. The Bank of England, if it yearned for membership of the E.C.A., could produce most excellent references; while an honest, intelligent wireman, starting as a contractor on limited capital, might find it difficult to give any references at all.

4. I am well aware that all members of the N.F.E.A. are supposed to comply with the terms agreed with the E.T.U. But surely this is beside the point. We are discussing the E.C.A., not the N.F.E.A. All members of the E.C.A. are not members of the N.F.E.A., and *vice versa*. Obviously, therefore, there are a comparatively large number of members of the E.C.A. who are under no obligation to pay their men at E.T.U. rates, and thus are at liberty to compete unfairly with other members who, by joining the N.F.E.A., have accepted that obligation.

Finally, Mr. Marryat is "amused" by my suggestion that the E.C.A. might enforce a minimum standard of wiring if it could count on the supply companies to report infractions. Divorced from its context, my suggestion reads like the blind leading the blind, but if he will re-read it he will see that it was dependent on the previous suggestion that the E.C.A. would be powerful enough to make the supply companies more amenable to its wishes than they now are.

I want again to assure Mr. Marryat that my article was written in no antagonistic spirit. No one would be better pleased than I to see the E.C.A. grow rapidly into the strong and powerful organisation that the industry needs to raise its status from its present low level. Where I—and many others, both members and non-members—differ from him and his Committee is in not being so completely satisfied that their present policy is that best calculated to achieve that end.

H. R. Taunton.

THE HUMAN SIDE OF ORGANISATION.

By W. J. HISCOX.

Despite the fact that the human side of industry has come to the fore during recent years, by the development of welfare organisations and the like, it cannot be said that the workers' suspicion of "innovations" is much less marked than it was, say, ten years ago. It is perhaps more in connection with "system" and shop procedure that he is still apprehensive, for he is educated sufficiently to appreciate the advantages of the labour-saving appliance, and the introduction into the factory of such a piece of apparatus does not as a rule cause a deal of comment.

But when a change of system is mooted—when a man is brought into the factory for the purpose of effecting a thorough reorganisation—then it is that suspicion is aroused, and the importation is regarded with hostility and dislike. He is looked upon as a "soulless" creature—a "sweater" and a "grinder"—a man whose whole mind is concentrated upon the problem of getting the highest possible yield for the lowest possible expenditure.

To the worker this implies harder work and lower wages, and the organiser is regarded as an enemy. The shop stewards have their eyes upon him, ready to catch him up should he trip, and he is the subject of much argument in the works manager's office. He is not attacked openly, for he is very exclusive, and is, as a consequence, regarded as formidable, but every opportunity for a covert attack is taken advantage of. He is obviously unable to defend himself, and is to a great extent unaware of the nature of the attack. Without any definite reason (save that of prejudice) his every action is construed into a direct challenge of the workers' aspirations, and the thought that he is a human being, with a full share of human emotions and human weaknesses, and that he is sensitive to the attacks made upon him, does not for one moment enter the minds of his detractors.

Yet he is intensely human, and he never once loses sight of the fact that he is dealing with fellow beings. He realises the influence his actions will have upon their lives, and those actions are formulated accordingly. His mission is to lighten the labourer's task, and yet make him more effective—to eliminate fatigue, and to stimulate interest. These are the points which inspire his policy, and which govern his every action.

He does not enter the factory full of the belief that the men are not working hard enough, or that they are too highly paid. On the contrary, he believes that they are working far too hard, and he would lighten their labours. He sees no reason why their wages should not be increased, and he is prepared to supply the necessary facilities.

He is a business man, but there is nothing inhuman in the term. It is true that the term has been (and is still being) abused by the unscrupulous who cloak their rank inefficiency under a barbarous guise of what they term "business." These are the people who are at the bottom of the so-called "labour trouble." Their methods cause the term "business" to emit a bad odour, and the victims fall an easy prey to the extremist "quacks."

The real business man is an honourable fellow, expecting and giving a fair deal, and the organiser will be found in this category. He is engaged for the purpose of providing the facilities whereby the product can be manufactured to *sell*, and this means that production must be increased and cheapened.

He recognises that the manufactured product is the direct fruits of Labour, assisted by Capital. Without the latter Labour would have to rely wholly and solely upon its own exertions, and as a consequence the energy expended would be tremendous, the output limited, and the workmanship (in many instances) decidedly crude. Capital added to Labour ensures a well-lighted and commodious factory, and the mechanical appliances which increase the output of the worker whilst reducing the expenditure of energy.

But, to ensure the best results, both Capital and Labour must be controlled and exploited, and it is here that management enters. It is obvious that, if a fair return is to be given to the working partners, the value of their product must exceed the cost incurred, and it is for management to ensure this. So a working system is drafted out and put into operation, this being devised to assist both Capital and Labour by giving each every opportunity to develop. It is designed to eliminate

waste and to arrange a wise distribution of capital with a view to affording the utmost assistance to labour. The machine becomes the unit of labour, controlled by the ingenuity of the man.

But business is progressive and must be ever marching onward. The "peak" of this year is the starting point for next, for the progress of industry must be commensurate with the progress of the human race. As we develop mentally, so our needs are of a higher order, and industry must supply those needs. A still wiser use must be made of Capital and Labour, and there comes a time in the history of every factory when further development can only be accomplished by a reconstruction of the system, and then it is that the organiser enters.

He is engaged to devise the ways and means whereby Capital and Labour may be more fully exploited. He is a specialist in the art of organisation, and his knowledge of methods and procedure outside that factory constitutes his strongest point. He has before seen situations similar to those constantly arising in the factory, and he knows from experience how they should be treated. He can speedily discover the weak places in the system, and he appreciates that those weak places constitute an injustice for some one.

This injustice is apparent in many forms, of which the following may be deemed representative, *viz.*: (1) the overworking of the individual; (2) the restricted scope afforded the individual; and (3) the failure of the individual to surmount the obstacles encountered.

An overworked individual is never really efficient, for his interests and responsibilities are too many and too diverse for each factor to receive the attention it deserves. His ability is taken advantage of by the management, for he is recognised as a "good" man, to whom the work may safely be entrusted. There is, however, a limit to every one's capabilities, and when that limit is exceeded efficiency begins to deteriorate. This is not recognised either by the management or by the man, for the latter sets out to do the best possible, and the management is convinced that nothing better can be obtained. Yet, were some of those duties delegated to other people, much better results would be secured, because of the higher standard of efficiency attained.

In every factory will be found the individual whose capabilities are not extended by the duties he is called upon to perform. His ability is recognised to a point, but he is kept at the job for which his proficiency is recognised, and, as a consequence, is not given the opportunity of showing the full extent of his capabilities. Just as efficiency deteriorates when the limit of one's capabilities is passed, so also does it deteriorate when development of ability is retarded by the mediocre character of the task assigned, for the individual, having no hope of advancement, or of exercising his ingenuity, degenerates into a state of apathy, and in course of time the very job itself suffers for want of attention.

The failure of the individual to surmount the obstacles encountered may be due to the formidable nature of these obstacles, and to the lack of assistance afforded by the management. The system here is directly to blame, for the individual, struggling to do his duty, is so hedged around by convention and precedent that he is quite unable to show good results for the energy expended and the ingenuity displayed. He is expected to show certain results, and could accomplish these but for the procedure insisted upon. As it is, he is constantly in trouble, and becomes soured and disappointed. He works hard, and receives but little thanks, and, if he remains for any length of time in such a position, he becomes a typical example of a "good man spoiled."

These are the facts which are apparent to the organiser before he has long been in the factory, and in seeking to remedy these evils it cannot be said that his motive is anything but humane. It is true that he is there for business, but, after all, business is a human institution, and the real efficiency and value of business is based upon a proper appreciation of the human element. If the organiser can improve the business of the factory by lightening the tasks of one man, providing the gate for the aspirations of another, and assisting a third to do what is expected of him, then surely he cannot be regarded as a "soulless creature," whose one mission in life is to enrich the employer at the expense of the worker.

But, perhaps, whilst giving him credit for his motive in this direction, it may be argued that so far he has confined his attention to the foremen and the other staff officials. From the worker's (*i.e.*, the mechanic's) standpoint, it may appear a good move on the part of the organiser to ingratiate himself with the heads of departments, for the latter may be used as his tools for the oppression of the working man. So much depends upon the foreman that undoubtedly he would prove a valuable ally, and his goodwill is therefore essential to the schemes of the organiser.

Thus argues the worker and, in his favour, let it be said that he has had cause to be suspicious of every move on the part of the management. He has seen new "systems" introduced, which have been followed by rate cutting and other crude "economical" measures. It perhaps cannot be expected that our present-day organiser will be regarded with immediate favour, for a stigma is attached to his profession by the action of his predecessors, and this must be removed before his motive can be appreciated by the workers.

As an organiser who has, at the outset, encountered the opposition and the prejudice of the officials and the workers of the factory, and who has ultimately won their goodwill and confidence, the writer is well able to appreciate the feeling which exists, and he can assert that the organiser is concerned as much with the welfare of the worker as with that of the factory official.

He is there to obviate rate cutting by eliminating the necessity, and to stimulate employment by producing an article which will sell. If a man, by working hard, can produce each week 40 articles at 2s. 6d. each, he earns £5 per week, but if, with a less expenditure of energy, owing to the facilities provided by the organiser, he can produce double the quantity at 1s. 3d. each, his weekly earnings have not decreased.

The man may argue that the only advantage he gains is that he does not work quite so hard, but because the illustration shows the cost per piece decreased by one half, this does not mean that every job will be reduced by this amount, neither does it mean that the increase of quantity in each case will be fixed at 100 per cent. The organiser is concerned, not with low wages, but with low costs per piece, and he is an advocate of high wages, provided that these yield the production which will ensure the lowest possible cost per piece.

It is the individual cost which determines the selling price of the product. It is the selling price which determines the market, and it is the market which determines the quantity to be produced, and, incidentally, the volume and continuity of employment. When but 40 articles per week are produced, the costs are proportionately high, the selling price is accordingly regulated, and the market is limited; but when the factory can produce 80 per week at approximately the same aggregate cost, the selling price per piece can be considerably reduced, there is a much wider market, and the chances of an increased demand are much greater.

The worker wants high wages and shorter hours, and these the organiser wishes to give him. He is prepared to go further than this, for he would minimise the arduous nature of the task. He provides facilities whereby the natural ability of the worker is reinforced, and every effort is rendered productive. All he asks in return is that the worker shall exploit those facilities to the utmost, so that the money expended will yield a good return. And in insisting upon this it cannot be shown that the organiser exhibits a lack of human consideration, for, as a result of his efforts, the worker benefits just as does the business.

WATER-POWER DEVELOPMENTS IN NORTH WALES.

THE COWLYD DAM.

The opening ceremony in connection with the new dam at Cowlyd Lake was performed by Sir John Snell, the chairman of the Electricity Commissioners, on Wednesday September 20th, in the presence of a large number of representatives of public bodies in North Wales who had accepted the invitation of the Conway and Colwyn Bay Joint Water Supply Board and the Aluminium Corporation, Ltd., which owns the controlling interest in the North Wales Power Co. The visitors met in the morning at the works of the company at Dolgarrog, situated in a delightful spot in the Conway Valley, and were conveyed up the steep narrow-gauge track which had to be constructed by the company to carry all the materials necessary for the construction of the dam. This track in places is "one in one," and the party had a nerve-racking experience before arriving at the top of the incline, where they were transferred to specially constructed trucks and were taken to the lake three miles distant right in the heart of the mountains, which form part of the Snowdon range. After inspecting the work, which was explained to them by the water board's engineer, Mr. C. F. Farrington, the party returned to Dolgarrog, and were entertained at luncheon in the assembly rooms attached to the works, which had been transformed into the semblance of an Eastern tent and charmingly decorated. Sir John Snell was presented by Mr. John Porter, the clerk to the Joint Water Board, with an Elizabethan goblet and cup, and having filled the goblet from a special pipe laid on the dining table he sipped the water, declared the dam open, and dedicated the waters behind it to the service of those who were entitled to it.

In proposing the toast "Success to the Cowlyd Dam," Sir John expressed his pleasure at being present to inaugurate the completion of such a scheme of conserving water power. He had the honour of being on a Committee appointed by the Government to consider as a matter of national economy what advantage could be taken of the natural resources of this country. The Committee felt that where water was required for domestic and sanitation purposes that had a prior claim over what was required for power purposes. Rain which fell into natural reservoirs, or was impounded, could, he felt sure, be used for the dual purpose, namely, for the health and sanitation of the inhabitants, and to provide a natural source of power. That was proved to be the case that day, as with public spirit the Water Board and the Corporation had joined together for the joint and wise use of the water they gathered for a dual purpose. That power could be used without destroying the amenities of the district was proved by the fine piece of engineering of which they were celebrating the completion that day. The dam had been raised forty feet not by an erection which was a blot on the landscape but by a natural dam. Nature had been assisted unseen, as the concrete and its strength was hidden away. The recent survey of North Wales proved that there were vast natural resources remaining to be developed. A short time ago the Chief of the Swiss Federal Railways informed him that in 10 years the whole of the railways in Switzerland would depend entirely on electrical transport, whilst all the towns would be lighted and heated by energy derived from the same natural sources of the country. Owing to this question of the development of natural resources having been neglected in this country British engineers had been ousted by the foreigners to a considerable extent. He was pleased to see, however, that they were advancing, as they were moving towards establishing a chair of hydro engineering at one of the Universities. South of the Caledonian Canal there was sufficient water power to do away with all the coal-driven power stations in Glasgow and other towns in the South of Scotland. He believed the completion of the Cowlyd Dam was only the beginning of a much wider development to take place under the North Wales Power Co. at Festiniog, and there were still other sources of power which could be tapped. He could foresee in the near future the L. & N.W. Railway from Crewe to Holyhead driven by electric power derived from the natural resources of North Wales, and the residents were assured of power for lighting, heating, and cooking, a power which God had blessed this country with.

Later, in reply to the toast of the chairman proposed by the Mayor of Conway, Councillor G. W. Hyde, J.P., Sir John appealed to the ground landlords in the district not to delay but to assist the company by granting way-leaves as by so doing they would be conferring a benefit on the general public.

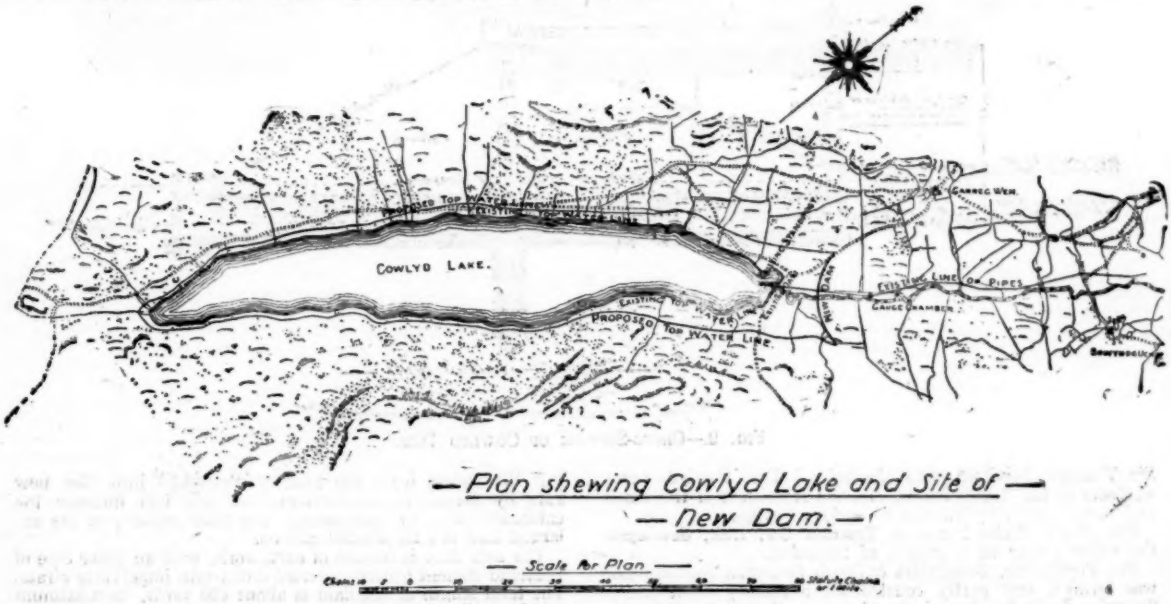

FIG. 1.—PLAN OF COWLYD LAKE AND DAM.

In reply to the toast of the Conway and Colwyn Bay Joint Water Supply Board, Mr. George Bevan, J.P., the chairman, said the Board was formed in 1891 before the great rush of English towns to Wales for their water supplies. The Board's agreement with the Aluminium Company had a two-fold effect; they were enabled to ensure the residents in the area supplied by the Board of a constant supply of water for domestic services, and on the other hand the surplus water was devoted to giving them a cheaper supply of electrical energy. This was being supplied by the company at 1½d. per unit, against the present cost of 4d. or 5d. per unit, the cost to produce by coal. The supply of electricity to Colwyn Bay by the company was giving every satisfaction, and Llandudno and Conway were hoping to get a bulk supply within the next few months. Next year the price of water supply would be reduced to 6d. The policy of the Board in entering into an agreement with the Aluminium Co. was, therefore, justified by the results. Ald. J. M. Porter, Denbighshire County Council, in responding to the toast of the Public Authorities, pleaded for less interference by Whitehall in local matters. There was a danger that continued interference would stop men from taking part in public affairs.

The toast of "The Aluminium Corporation," was responded to by Messrs. R. Taylor, a director, and Henry J. Jack, the managing director of the company; the latter paid a tribute to his staff for the loyal co-operation they had given him in the work. That day marked an epoch in the public history of North Wales. It was essential that the natural

resources of the country should be conserved as it had been recently stated that the South Wales coalfield would be seriously depleted within the next 60 years. If that were true then prices would naturally harden and working costs would increase. By developing the water powers of North Wales they were providing for those who would come after. If one's ideal of work did not include work for the public weal, life became a barren thing. He was touched greatly by the presence of Sir John Snell, who had broken his holiday to be present. If the work of developing the natural resources of the country was put in hand at once they could provide work for many of those who had fought for their country and were tired of living on doles. When the dam started it was anticipated it would cost £70,000 and he had the money in the bank to pay for it, but through the war the cost had mounted to over £250,000.

The toast of "The Engineers" (Sir Douglas Fox & Partners and Messrs. F. B. Farrington & Son) was responded to by Mr. C. F. Farrington, and that of the contractors, Sir Robert McAlpine & Sons, by Mr. A. McAlpine. During the proceedings songs were given by local artistes and selections by the works orchestra. In the evening a carnival ball was held.

The following is a brief history of the companies formed to develop the water powers in North Wales:—

Many years ago, far-seeing pioneers formed a company called Gwalia, Ltd., and acquired all the important water rights of Snowdonia, their freehold land extending from the Conway Valley to the Western Slopes of Snowdon. Unfortunately, history repeating itself, support was lacking, and the company was unable to carry out its development. Part of the water rights was sold to a company called the North Wales Power & Traction Co., Ltd., of which the late Sir Thomas Beecham was chairman. The Cowlyd Lake was sold to the Water Board, and the remainder of the lands and water rights by auction to various buyers.

The North Wales Power & Traction Co., Ltd., developed the water power on a portion of Snowdon.

The Portmadoc, Beddgelert & South Snowdon Railway Co. was formed, and partly constructed a railway from South Snowdon to Portmadoc, designed to use the power, but was unable to complete.

The Snowdon Mountain Tramroad & Hotels Co. was formed, and built a rack railway to the summit of Snowdon, but failed to use the hydraulic power.

The Oakeley, Dinorwic and Penyrorsedd Quarry Companies were the first people to realise the advantages of the cheap energy, and transmission lines connecting Cwm Dyli Power Station to their quarries were built and put into operation in 1906.

Later, the North Wales Power & Traction Co., Ltd., sold their land and water rights in the Conway Valley to the Aluminium Corporation, and this portion of the power was developed and a 20,000-volt transmission line 13 miles long, to connect the two power stations at Cwm Dyli and Dolgarrog, was constructed.

In 1918 the Aluminium Corporation purchased the controlling interest in the North Wales Power & Traction Co., Ltd.

The Cowlyd Valley water rights were originally the property of Gwalia, Ltd., and the lake was the basis of the original scheme of development. The dam, therefore, completes the original scheme of hydraulic development for Snowdonia, as envisaged by the pioneers who formed Gwalia, Ltd., so many years ago, and it bodes well for the future of this great conception that the control of the North Wales Power Co., the Aluminium Corporation, the Portmadoc Beddgelert & South Snowdon Railway, the North Wales Narrow Gauge Railway, the Festiniog Railway Co., and the Snowdon Mountain Tramroad & Hotels Co., Ltd., is centred in one office at Dolgarrog.

Nearly thirty million units of electricity were actually generated by the two stations during the past twelve months; the storage capacity has now reached a total of 780 million cubic feet; there are over 100 route miles of high-pressure transmission lines in operation; practically all the slate and granite quarries of North Wales are supplied with energy, together with the Marconi Wireless Station and the town of Colwyn Bay; the towns of Llandudno, Conway and Bangor will be connected in the course of the next few weeks, while plans are in active progress to extend the network of transmission lines over the 4,000 square miles of North Wales from Holyhead to Crewe. The aluminium manufactured by this Welsh water from the ores produced by the company's mines in the South of France, is well known and bears a high repute all over the world.

Cowlyd Waterworks.

The following extracts from a paper read by Mr. C. F. Farrington before the Liverpool Engineering Society are printed by permission of the Council of the Society:—

Llyn Cowlyd is situated in the heart of the Carnarvonshire range of mountains, about four miles from Llanrwst, three miles from Trefriw, and two miles from Capel Curig. Its extreme length is nearly 1¾ miles, its extreme width over a quarter of a mile, and the top water level is 1,206 ft. above Ordnance datum. The watershed, which is owned by the Board, has an area of about 1,250 acres, with an average annual rainfall of 90 in.

The Board and the Corporation are entitled to draw the available water in the lake above the level of 1,170.50 ft. above Ordnance datum for the purposes of their respective undertakings, but the Board is alone entitled to the whole of the water in the lake below 1,170.50 above Ordnance datum.

The Corporation is now carrying out a scheme for bringing the waters from the Llugwy watershed into the new lake by means of catchwaters, and this will increase the catchment area by 1,880 acres. The total capacity of the enlarged lake is 3,110,000,000 gallons.

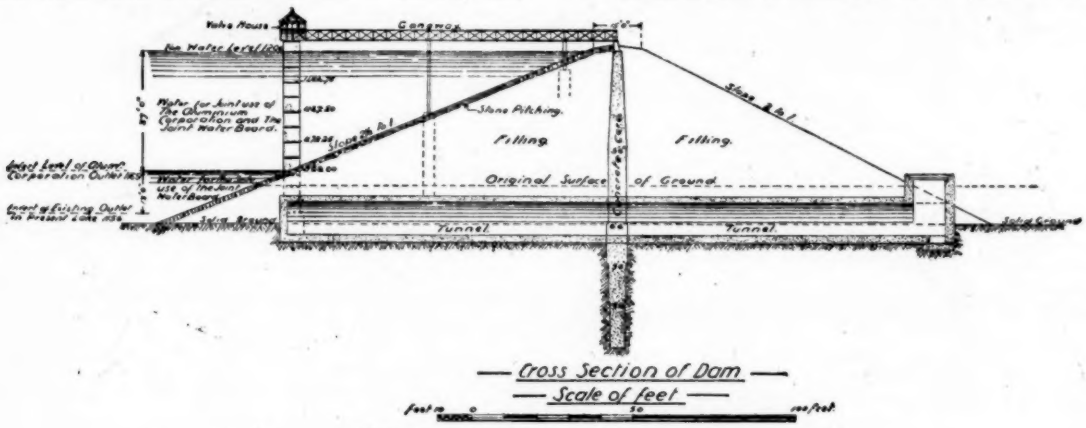

Fig. 2.—Cross-Section of Cowlyd Dam.

The new dam is formed of earthwork, with an inner core of Portland cement concrete carried down into impervious strata. The total length of the dam is about 450 yards, its maximum width at the base is 72 yards, the maximum height above original ground level is 45 ft., and the greatest depth of the core wall below original ground level is 50 ft. The concrete core wall, for the full depth of the excavations, varies in thickness from 4 ft. 6 in. at the bottom to 6 ft. 6 in. at solid ground level, at which level the concrete is reduced to 5 ft. 6 in. in thickness. At this thickness it is carried to 1,176 ft. above Ordnance datum and then to a height of 1,206 ft. above Ordnance datum, the thickness of the concrete being reduced by battering on both sides to 2 ft. 6 in. at the top. The core wall is reinforced by steel rods ¾-in. diameter, 2 ft. apart vertically, 4 ft. apart horizontally, from 6 ft. below solid ground level, both sides of the wall and 4 in. from the face of wall, to 6 ft. from the top, with stirrup bars 4 ft. each way. The spillway—160 ft. wide, 1,206 ft. above Ordnance datum—which is constructed entirely of concrete, has a foundation of solid rock.

A rectangular concrete tunnel with semi-circular roof, 11 ft. wide by 10 ft. 6 in. high, has been constructed through the dam for the purpose of conveying the outlet pipes, &c., of the Water Board and Corporation. The inner slope of the dam is 2½ to 1 with 15-in. stone pitching fixed on edge, and the outer slope 2 to 1 seeded. The top of the dam is 15 ft. wide, and has a rubble stone storm wall built on top of the concrete core to a height of 1,211 ft. above Ordnance datum.

In the construction of the dam electric power was freely used—for quarrying and crushing stone, haulage, concrete mixing, &c. The supply of electricity was obtained from the Cwm Dyli Power Station, situate at the foot of Snowdon, whose transmission line passes through the Cowlyd Valley, a transformer reducing the voltage from 20,000 to 440 volts for use at the works.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The "Santon" Switch Plug.

Fig. 1 illustrates a new switch plug manufactured by Messrs. Santon, Ltd., 34, Bridge Street, Newport (Mon.). This is so designed that it cannot be removed while the current is "on," and its rated capacity is 15 A, although it will safely withstand 25 A. By a spring action "making" and "breaking" is executed instantaneously on both poles independently of the speed of operation.

The plug is wired by inserting the wires through an aperture in the front and bringing them to cheese-headed screw terminals. The end cap has recesses for these screw heads, and it also has a wedge-shaped projection which acts as a separator and cord grip for the leads. The flange of the plug is metal covered, and the corresponding surface of the base also has a metal cover mounted on a thick insulating washer.

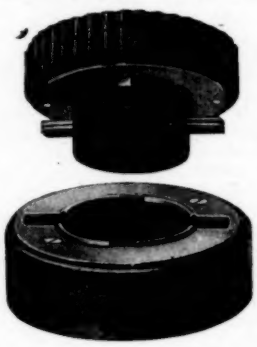

Fig. 1.—The "Santon" Switch Plug.

The M.B. Electric Soldering Iron.

The M.B. Electrical Co., 105, Whitta Road, Manor Park, E.12, has designed an electric soldering iron which possesses several new features, making it a compact and efficient workshop appliance. The iron is illustrated in fig. 2. The heating element is in cartridge form and, therefore, easily replaceable for a different voltage. The copper bit is made from the solid bar, with a shank extending into the element, this giving a continuous path for the heat to the tip. The nickel-plated body is of the same diameter as the head of the bit, enabling the iron to enter into corners that are not usually easily accessible. The loading is equal to about 127 watts, which makes the cost of operation practically negligible even for long periods. A substantial wooden handle is fitted, rendering the use of the appliance comfortable and safe. The leading-in wires are secured by a cord grip which takes all strain off the terminals. The iron is easily dismantled and re-assembled.

The firm also supplies an adjustable stand upon which the iron can be mounted to enable a succession of joints to be brought up to the iron, freeing the operator's hands and permitting him to employ them in holding the work. Another device supplied is a three-heat switch for regulating the supply.

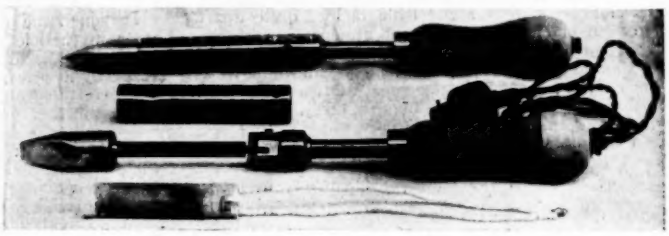

Fig. 2.—The M.B. Soldering Iron.

The "Adjusto-Lite" Fitting.

An electric light fitting which has a considerable vogue on the American Continent has been placed upon the British market by Messrs. S. Guiterman & Co., Ltd., 35 and 36, Aldermanbury, E.C.2. This is a reflector fitting mounted upon a short standard, the base of which fits into the top of a strong spring clip. This clip enables the fitting to be attached to any projecting part of furniture, &c. The "Adjusto-Lite" is made of brass in three different finishes, it is 12 in. in height, the reflector is 5¼ in. in diameter, and the clip measures 3 in. by 5 in.; it weighs 20 oz.

Trade Union Membership.—Statistics of trade union membership appeared in a recent issue of the *Ministry of Labour Gazette*. It is shown that from a total of 4,189,000 in 1913 the number steadily rose to 8,493,000 in 1920. Since that year membership has been declining for several reasons, and in 1921 it had fallen to 6,793,000—a decrease of 20 per cent. on the year. In 1920 the total number of such societies known to the Department was 1,425, but amalgamations reduced this to 1,296 in 1921. Some persons are members of more than one society, and making due allowance for this the net total membership for the United Kingdom is about 6,700,000. The iron-foundry, engineering, and shipbuilding unions lost about 82,000 members during 1921.

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The British Association on CO_2, CO and O Recorders.

In his paper before the Engineering Section of the British Association, Engineer-Commander Fraser Shaw (chief engineer of the Fuel Research Station, Greenwich) made some very interesting comments on CO_2 recorders.

Commander Shaw pointed out that a CO_2 record alone does not show the true state of combustion and that the CO or O must be known in addition. That is clear enough. Where there are three factors two must be known before the whole is clear. But snap tests for CO or O are of very little value. They must be recorded in the same way as the CO_2 is recorded by continuous control. My firm has been working on this problem for some time and we have brought out the "Arkon" combined CO_2 and O recorder for this very purpose. This instrument is a twin recorder with separate analysis and two charts but drawing its gas from a single pipe. Caustic potash is used for the absorption of the CO_2 and stick phosphorus for the O.

The instrument is made for water drive (see illustration) and for electric drive. The latter is preferred in the few cases where a water supply and drainage is not convenient.

These recorders are by no means experimental but have a fine record of useful service in many different branches of industry. Of course, where a CO_2 recorder is already in use only an oxygen recorder is required to supplement it.

Now as to CO. It is my firm opinion that the fear of CO is very largely groundless. I would almost say that our industrial boiler plants would be none the worse for a little CO in the flue gas. Most boiler plants up and down the country stand in no danger of it.

The proportion of boiler plants which have CO_2 recorders (or indicators) installed is probably between 10 per cent. and 20 per cent. The 80 per cent. to 90 per cent. of plants *without* CO_2 recorder are not in any danger of having the wasteful CO in the flue gases.

Of the remainder, the only plants in danger are those which have been tuned up to a very high pitch with CO_2 recorders constantly in use and with a restricted air supply. Further, of these cases CO is possibly only in plants steaming with easy load. A demand for "more steam" chases all CO out of the flue gases.

Some boiler furnaces, of course, are structurally defective and cannot complete the combustion properly. That is a fundamental condition and not an operating condition.

In fact, no steam user need be disturbed by the fear of CO in flue gases. We are not really near to it yet. Our boiler plants will be working much more efficiently when we are.

In CO recording there are many difficulties in the way. The absorption in cuprous chloride (as used in the Orsat test) is too slow for an automatic recorder, so that recourse is made to burning the CO to CO_2 either by means of an electrically-heated wire or by a tube of copper oxide heated by a bunsen burner. There are, in addition, difficulties in the way of volumetric measurement. The net result is that only one CO recorder, the "Mono" recorder of Sweden, has found its way on the market as yet.

But as I have said above, the average boiler plant will not yield any CO and when it does yield it, steps are taken to stop it at once. Therefore, when a CO recorder is installed on a properly worked boiler plant it shows nothing on its chart! That is quite sound for the economics of boiler plants but psychologically it is rather deadening. Why put in a recorder which will not and should not show anything on the chart?

On the other hand, the oxygen content will usually be round about 6 per cent. which is quite a measurable quantity. clearly shown on the chart. And as the root of all combustion troubles is excess of air, this recorder puts another check on it.

A particular application of the combined CO_2 and O recorder which may interest some of your readers is the case

of boiler or furnace firing with blast-furnace gas. As there is already some CO_2 in the unburnt gas the final CO_2 alone is not a proper guide to the combustion and a second check is necessary. This is furnished by the oxygen part of the twin recorder.

Another case is kiln firing. The CO_2 record alone is misleading because of CO_2 escaping from the material being dried. In this case also the combined CO_2 and O recorder gives a real check.

W. W. Crosweller, A.M.I.Mech.E.
Walker, Crosweller & Co.

London, *September 26th*, 1922.

Power Station Engineers' Salaries.

A point that is not often given the prominence it should have is that the salaries of the technical staff are but a small fraction of the total cost of generation and distribution; coal, capital costs, and wages (as distinct from salaries) are the big items.

Taking as a concrete case the undertaking I am with (figures being approximate only), the yearly output is about 40,000,000 units, and the salaries of the technical staff amount to about £14,000 per annum; this works out, roughly, at 1/12d. per unit, a small item in the total cost of the latter. So, if salaries were halved (which Heaven forbid), the resultant saving would not be a very appreciable factor, quite apart from any question of efficiency and contentment. As can be seen by a study of company and municipal reports, the bulk of the country's undertakings are more than paying their way. I suspect the employers are out to reduce salaries more "on principle" than for the alleged economy resulting; there is also the moral effect on the wage earners to be considered. Remembering the scandalous pay and conditions of the staff employés (and to a lesser extent the workmen) in pre-war days, I think the E.P.E.A. could afford, in justice, to press for a rise in salaries. Judging by the recent action of the British Medical Association in boycotting an underpaid (in *their* opinion) appointment, it would appear that the E.P.E.A. could with advantage take a leaf out of their book. The doctors get practically what they demand, solely by their solidarity, and not on the merits of the case at all.

Further, the *Labour Gazette* cost-of-living figures are, as is notorious, quite unfair to staff men, being applicable mainly, judging by the necessaries mentioned, to "buck" navvies only.

It is to be hoped the E.P.E.A. will follow up the Civil Service associations and others, and endeavour to get a fairer basis for these figures.

K. V. A.

September 19th, 1922.

How to Buy.

On reading the article in the Electrical Review for September 15th "How Not to Buy," the only remedy appears to be as outlined by your correspondent: "Not to Buy at all."

I think most contractors will bear me out that the factor's traveller does not misrepresent (I will not say lie) to such an extent as the manufacturer's traveller. The factor, after making a promise, has very little excuse for not keeping it, but the manufacturer can always point to labour troubles and raw material over which he has no control, and it must be obvious to anyone who has done any buying that if there is any delay at all, it must be owing to the manufacturers not being able to deliver.

As regards stocks, I can name quite a number of factors who hold far more stocks than manufacturers, and if the factor rings up a dozen or so other factors, and probably the manufacturer as well, and none of them has the particular article in stock, what advantage would the contractor have in sending his order direct to the manufacturer?

On the other hand, he has a distinct advantage in knowing that a factor will supply from one source or another, if it is possible to procure the goods.

The whole article seems to be written with the idea that the factor's traveller is a liar, and secondly, that he obtains his business in the public house, which is a libel on any representative whether working for a factor or any other section of the electrical industry.

The contention that any contractor can be a factor by having his paper printed as such merely shows the inaccuracy and want of experience of the writer.

It is only a few years since one of the largest manufacturers in the country determined to do without factors as being an "unnecessary evil," but to-day they are endeavouring to get the factor to support them again by offering special inducements, and the reason is that the factor must buy in large quantities, and meet his accounts when they become due, and have (inside) men who have far more knowledge than just to carry out travellers' promises.

I consider this article is in very bad taste, and one which should not have been written, as it is not helpful either to manufacturer, factor, or contractor.

W. C. Jeary,
Managing Director.
The Jeary Electrical Co., Ltd.

London, *September 19th*, 1922.

Estimating for Internal Wiring Contracts.

In your issue of the 8th inst., "Lodestone," in commenting upon my article on estimating for internal wiring contracts, gives three basic reasons which he thinks account for the discrepancy in prices of tenders, namely:

1. Faulty specifications.
2. Failure of proper supervision by the purchaser.
3. Lack of standards for materials.

Incidentally he makes out a very strong case in favour of the adoption of electrical bills of quantities, because by the employment of that method the first and third of his basic reasons would be eliminated. His second basic reason is so unsound, both in principle and fact, that I am astounded to see such an excuse advanced by an electrical contractor who claims experience and standing.

"Lodestone" asserts that failure of proper supervision by the purchaser (or adviser) is a definite cause of price difference in estimated costs, but the only way by which the estimated costs could be affected would be by the tenderer taking advantage of a known laxity on the part of the adviser and consequently allowing in his estimated costs for a deliberate scamping of the work.

"Lodestone" apparently does not appreciate my dictum that the proper carrying-out of a contract is a joint liability shared by the adviser and accepted contractor, wherefore a neglect of duty by one party does not exonerate the other party from a proper execution of his contract.

With regard to the details enumerated by "Lodestone," it can safely be asserted that the remedy for all such evils lies in the adoption of electrical bills of quantities, whereby definite quantities of specified materials are given to the tenderers for pricing, accompanied by all necessary plans and specifications which enable the tenderer to estimate accurately the labour costs of erection.

Alan Kirk.

London, *September 25th*, 1922.

Trade Jealousy.

The most delightful example of jealousy I ever heard of came to my notice the other day, and your readers will no doubt be pleased to share the laugh it has caused.

A well-known firm of electrical engineers engaged on the installation of a public electricity supply not 50 miles from here sent to the local gas company's works for coke breeze, in which to bury an earth plate, but on learning the use to which the breeze was to be put the company's servants refused to supply it!

W. E. P.

Redcar, *September 24th*, 1922.

BUSINESS NOTES.

Bankruptcy Proceedings.—Joseph Richardson Norris, trading as the Acme Electrical Co., of Norbreck.—At Blackpool Bankruptcy Court, on September 22nd, this examination took place. The deficiency, on gross liabilities of £812, was estimated to be £564. Debtor attributed his failure to bad trade and losses on contracts. He stated that he first commenced in business at Oldham as J. R. Norris & Co. with £150 capital of his own. He later traded at Prestwich until 1921, when he came to Blackpool. He had confined his activities to contract work only. The examination was adjourned.

Clarence Albert Sidebotham, of Keswick Road, Blackpool.—This examination was also adjourned. Debtor attributed his failure to bad trade, sickness, and the failure of Farrow's Bank. There was an estimated deficiency of £150. Formerly a commercial traveller, he commenced business with a capital of £60 as a merchant dealing in electrical fittings. He did not think there had been any profit in the concern.

H. J. A. Maullin (Wilton Engineering Co.), electrical engineer, 124, Devonshire Street, Birmingham.—First meeting, October 5th, at the Official Receiver's Office, 191, Corporation Street, Birmingham; public examination, October 25th, at the Court House, Birmingham.

H. Garniss, electrician, 107, Beverley Road, Kingston-upon-Hull.—First meeting, October 2nd, at the Official Receiver's Offices, York City Bank Chambers, Lowgate, Hull; public examination, November 13th, at the Guildhall, Hull.

T. Scott and J. Campbell (T. Scott & Co.), wholesale electrical suppliers, 42, Handysides Arcade, Percy Street, Newcastle-on-Tyne.—First and final dividend of 1s. 8½d. in the £, payable October 5th at Messrs. Brittain & Brittain, Pearl Buildings, Northumberland Street, Newcastle-on-Tyne.

B. T. Dale, electrical engineer, Erick Street, Newcastle-on-Tyne.—First and final dividend of 2s. 2½d. in the £, payable October 4th, at Messrs. Brittain & Brittain's offices, 4, Northumberland Street, Newcastle-on-Tyne.

C. J. Haxby and E. Brady (Haxby & Brady), electrical engineers, 1a, East Parade, Harrogate.—Receiving order made September 22nd, on debtors' own petition.

E. Durden & Co., electrical engineers, 13, Queen Street, Liverpool.—Receiving order made September 21st, on creditors' petition.

J. F. Ludlow and R. R. Ludlow (Ludlow Bros.), electrical contractors, 196, Church Road, Redfield, Bristol.—First and final dividend of 8½d. in the £, payable at the Official Receiver's Office, Bristol.

Company Liquidations.—Rapid Submersible Ship Cleaner Co., Ltd.—At the annual meeting, held in London last week, Mr. B. A. Levinson stated that, in consequence of want of funds, it had been decided to recommend the shareholders to wind up the company. He referred to efforts that had been made to put the plant to commercial use. They had cleaned some large steamers, but through bankruptcy their bill in one case was not met. Their finances ran out and the bank pressed for payment of the overdraft secured upon the wharf. They had also had correspondence with a view to disposing of the rights or of licences, and had correspondence with reference to the Straits Settlements and South America, and if they had had sufficient finance they would have been able to continue and to apply themselves principally to making arrangements for working the process in tropical waters. The resolution to wind up the company was carried.

Wareham Electric Supply Co., Ltd.—Winding up voluntarily. Liquidator: Mr. A. H. Edwards, Cornhill Chambers, Doncaster. Meeting of creditors, October 2nd. Particulars of claims to be sent to the liquidator by October 20th.

John Brotherton, Ltd.—Winding up voluntarily. Liquidator: Mr. M. Wilkie, 22, Darlington Street, Wolverhampton.

Trade Announcements.—Mr. W. F. Haldane has been appointed manager of the Dublin office of the British Thomson-Houston Co., Ltd., in place of Mr. E. C. Handcock, who left the company in April last.

Automatic & Electric Furnaces, Ltd., are removing to larger premises to meet the growth of the business. Their address from to-day, Friday, is Elecfurn Works, 173-175, Farringdon Road, London, E.C.1. ('Phone: Clerkenwell 5234; tele.: "Elecfurn London.") New machine tools, &c., are being installed to improve deliveries, and there will be new demonstration rooms equipped with large and small electric furnaces, and muffles will be shown in operation.

Venner Time Switches, Ltd., have taken over a foundry for casting their aluminium boxes, owing to the growth of their time switch business, and they are open to deal with requirements in gunmetal, brass, or aluminium castings, and pattern making.

Messrs. Falk, Stadelmann & Co., Ltd., are hurrying forward the restoration of their buildings at Glasgow, which were visited by a disastrous fire on September 11th. For a week or two London stocks will be drawn on through a specially set-up Glasgow department in London, and a daily air-service between Glasgow and London is being taken advantage of. Communications for the branch should be sent to the temporary address: 19-21, York Street, Glasgow.

Messrs. Mayall & Co., Ltd., electrical and mechanical engineers' merchants, Birmingham, have recently appointed Mr. R. E. Akers, who will reside at Christchurch, as their sole representative in New Zealand.

Messrs. Harris & Russell, factors, have removed from Dyers Buildings, Holborn, to 3, Percy Street, Tottenham Court Road, London.

Catalogues Wanted.—Mr. J. C. Elvy, 12, Tavistock Street, W.C.2, wants particulars of electrical equipment for slate quarrying.

Catalogues and Lists.—Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., U.S.A.—A profusely-illustrated brochure upon mine and industrial locomotives, showing numerous types developed by the Westinghouse Co.

Messrs. C. F. Elwell, Ltd., Craven House, Kingsway, W.C.2.—An illustrated pamphlet giving particulars and prices of cabinet receiving sets, portable sets, loud speakers, valves, and other "wireless" components.

Messrs. Falk, Stadelmann & Co., Ltd., 83, 85 & 87, Farringdon Road, E.C.1.—Catalogue No. 484, giving prices and details of condensers, head telephones, aerial equipment, and other "wireless" accessories.

Messrs. Santon, Ltd., 34, Bridge Street, Newport (Mon.).—An illustrated pamphlet descriptive of "Santon" switch plugs.

A.G.E. Electric Motors, Ltd., Stowmarket. (London representative, Mr. Thomas T. D. Geesin, 4, Clevedon Road, S.E.20).—Two well-illustrated brochures dealing with "Bull" d.c. dynamos and motors, together with a card giving net trade prices.

The General Electric Co., Ltd., Magnet House, Kingsway, W.C.2. Booklet No. B.C. 2815.—An illustrated catalogue, giving full details and prices of "Gecophone" crystal and valve wireless receiving sets, components, and accessories. Details of aerial erection are included.

The Pulsometer Engineering Co., Ltd., Nine Elms Iron Works, Reading.—An illustrated and priced pamphlet describing the "Pulsometer" ring pump—a new design.

Book Notices.—"Filtration," by T. Roland Wollaston, M.I.Mech.E. (102 pp.). London: Sir Isaac Pitman and Sons, Ltd. Price 2s. 6d. net.—A sub-title describes this work as "an elementary treatise on industrial methods and equipment for the filtration of liquids and gases for those concerned with water supply, ventilation and public health, chemists, mechanical engineers, and others." The bulk of the volume is devoted to the treatment of water, and for this reason is likely to be of assistance to students of power station operation. The numerous types of filter are described in sufficient detail and the work is well illustrated. The filtration of oil and air receives treatment in separate chapters; but the author is not one of those who believe that filtered and clarified oil retains the whole of its lubricative value. In the chapter on air the quotation of a long passage from the *Observer* on the evil effects of atmospheric pollution seems to be somewhat superfluous.

"Working Diagrams of Valve Amplifying Receiver Circuits," arranged by H. W. Sullivan. London: H. W. Sullivan. Price 1s.—This is the fourth edition of these diagrams, and includes a number of additions. The principal improvements are diagrams of switching arrangements to control the number of valves in operation, and a plate (No. 33) showing the method of adding a note-magnifying valve to the circuits shown in other diagrams. Thirty-four plates appear in this edition. For amateurs not versed in the reading of electrical diagrams, the last plate provides means of identifying the various components of a valve receiving set.

"Handbook of the Electric Power Club" (364 pp.). Cleveland (Ohio): The Club. Price 50 cents.—The Electric Power Club, Cleveland, is an association of manufacturers of electric power apparatus and control equipment, organised for the standardisation, improved production, and increased distribution of electrical machinery and apparatus. Its handbook, of which the present is the 14th edition, contains definitions, symbols, &c., and is a compendium of the standardisation work executed by the Club in electric motors, generators, transformers, tools, locomotives, and switchgear, and in many other branches of the industry. The Club has recently issued a bulletin, which gives what are believed to be the first attempts at standardising portable electric drills. This bulletin lays down voltages, frequencies, cutting rates, &c. A note in the publication shows that the Club's activities extend to Canada.

"The Brown-Boveri Review" for September contains a detailed description of the erection and testing of the single-phase alternators for the Ritom (Switzerland) power station, which supplies power to the Gothard section of the Federal Railways. Several excellent illustrations accompany the article. Other subjects dealt with in this number are the firm's "Type E" switch-boxes, motors for centrifugals, and mercury arc rectifiers for d.c. pressures of 5,000 V.

Messrs. Haseltine, Lake & Co., of Southampton Buildings, London, W.C.2, have issued for the use of their clients (there is a charge of 10s. 6d. for extra copies) a booklet of 64 pages entitled "Information on the Subject of Trade Marks." It deals with the subject in a general manner, and endeavours to remove misconceptions which they have found to exist regarding the legal and semi-legal considerations involved. The definition and function of a trade mark; its value; the effect of registration; infringement; selection; validity and maintenance; and how to apply for registration are among the points covered. The classification of goods is also referred to as well as registration abroad and registration at Customs.

"The *Bulletin* of the Hydro-Electric Power Commission of Ontario," August. Toronto: The Commission.—The bulk of this number is devoted to salesmanship notes. An educative article shows the necessity for public "utilities" to sell appliances to their own employés first. The article is based on a questionnaire which, while showing that employés were somewhat behind expectations in their use of electrical appliances in their own homes, would no doubt compare very favourably with the position in this country; but this, of course, would apply to the general use of appliances also. The technical part of the *Bulletin* deals with lamp testing, and the choice of suitable distributing cables.

"Universal Directory of Railway Officials, 1922." (Pp. 644+101). London: The directory Publishing Co., Ltd. Price 20s. net. The 28th edition of this valuable work has not altered in form to any extent. It is pointed out in the preface that the grouping of the railways of the United Kingdom which is now in progress will probably involve considerable changes in *personnel* and organisation, but it is unlikely that the directory will become out-of-date before its next appearance. The immense scope of the work may be gauged from the fact that nearly 3,000 railways are dealt with, including 564 in the British Isles. The term "railways" has been interpreted in a technical sense, and for this reason the work contains details of the officials of tramway systems and numerous light railways. Special value attaches to the list of countries covered, and the personal index of railway directors and officers, comprising about 22,000 items.

The volume is strongly bound, and its size is small for the amount of information embodied in it.

Journal of the American Institute of Electrical Engineers. Vol. XLI, No. 9, September, 1922. New York: The Institute. Price $1.

German Electrical Exports in 1920-22.—In the Festival number of the *Elektrotechnische Zeitschrift*, published on the occasion of the 28th annual meeting of the Union of German Electrotechnicans at Munich, 1922, an article is published in which the position of German electrical export trade is reviewed. It states:—

"Before the war the output of electrotechnical products of the whole world amounted to a value of about four milliard gold marks. According to the then development of the electrotechnical industry, and the world's demands for its products, it might be reckoned that, saving any great disturbance of production, this output could be doubled in seven years. Whether that has occurred or not, the statistics to hand do not allow of our ascertaining. A considerable increase in the world's electrical output since the period before the war has, however, actually taken place albeit the economic power may have received a serious setback. The greatest increase in output possibilities has undoubtedly occurred in the United States. The extension of their electrical industries in the other combatant countries was hindered by the war. A considerable increase in later years has taken place in France, where there is talk of a doubling of the production. England, too, may institute a notable extension of its electrotechnical industry. Germany, which before the war produced about one-third of the aggregate production of the world in the electrotechnical department, was forced by the hostile alliance to take a back seat and yield up its preponderating lead as regarded quantity of products—not to England as was believed in some quarters—but to the United States. How far German production in some branches, which depends less on the economic conditions (as weak current articles, meters, glow lamps, &c.) has reached the peace level, or even a little beyond, cannot at the moment be stated. An exact estimate of the development and present position of the world's output of electrotechnical products is difficult to ascertain owing to the currency situation in each country. On this account it is especially difficult—almost impossible—to form an estimation from the published export values and export quantities. The English statistics of general foreign trade appear to be the only ones which carry out since the war a blameless method of value fixation as they give side by side with the declared value of present-day exports the export quantities, enabling thereby a comparison of the export values both before and since the war. As for the rest of the countries the declared value appears only in dollars, French paper francs, Swiss paper francs (gold francs since the end of the year only), paper marks, &c. It is attempted in the following table (ignoring the quantities) to ascertain from the declared values the peace value of the present exports, in order to make a comparison with 1913.

Land.	1913.		1920.		1921.	
	Absolute worth of the exports reckoned in gold marks.	Share in the total exports of five lands. Percentage.	Absolute worth of the exports reckoned in gold marks.	Share in the total exports of five lands. Percentage.	Absolute worth of the exports reckoned in gold marks.	Share in the total exports of five lands. Percentage.
United States	9·5	16	36	34	34	40
England	13·0	22	18	19	24	28
France	3·6	6	6	8	4·6	6
Switzerland	2·1	3·5	5	5	4·8	5
Germany	30·0	52	22	34	12	21

"In this table are given only the five principal exporting nations. The export of electrotechnical products in these countries is indicated by mean value in millions of marks. Column one contains the absolute worth of the exports reckoned in gold marks—in the case of the dollar, which has a full gold currency, the value is taken from the par quotation; in the case of England and Switzerland, from the average of the year's value; in the case of France, from a three months' average, for greater exactness; in the case of Germany, from the monthly averages, to allow for the changes in the currency value. In 1913 Germany occupied the first position as an exporting country, and England, although a good way back, the second, America, France and Switzerland following; now the order is:—America, England, Germany, France and Switzerland. While, therefore, all the other countries have been able to see their exports rise, and even France (from 3.6 to 4.6), Germany's volume of 30,000,000 gold marks in 1913 has shrunk in 1921 to 12,000,000 gold marks monthly mean value, or, in other words, the share of Germany in the aggregate exports of the principal countries has fallen from 32 per cent. to 21 per cent. But it is not to be wondered at that Germany's electrotechnical exports should have gone back, both actually and relatively, to this extent. Middle and Eastern Europe are economically bankrupt and unable to buy. The hostile alliance withholds with all its might from importing German products, while a circle of neutral States, under the pressure excited by cheap German products, have set up a wall of import taxes and restrictions against German goods. The English Colonies forbid, for the most part, the import of German electrotechnical products. The United States have always levied high protective duties, in order to destroy all industrial competition in their home market. The rest of the world is too small to be considered, and has, moreover, suffered from the consequences of the war, so that it has no great meaning for the German electrotechnical industry."

Development of an Electricity Supply Scheme.—Messrs. Sir Chas. Bright & Partners, Ltd., have been appointed consulting engineers to the Western Electric Distributing Corporation, Ltd., which controls and operates electric supply companies in the following towns: Tewkesbury, Chippenham, Trowbridge, Melksham, Leominster, Cirencester, Abingdon, Ledbury, Ruthin, Stroud, and Warminster. We understand that Mr. A. H. Seabrook has joined the board of the company, and that financial interests in the City of London having guaranteed a large additional capital, the company's operations will immediately be extended.

French Electrical Investments.—According to the statistics of new capital investments in the first quarter of the present year, the French electrical industry was responsible for 511,000,000 fr., divided as follows:—Share capital of new companies, 11,765,000 fr.; increases of capital, 59,167,000 fr.; and bonds, 440,206,000 fr. These figures far exceed those of other branches of industry, even those of food supply, which shows the growing importance of the electrical industry and the favour its securities enjoy among the general public.

Wages in the Tramway Industry.—Sir David Shackleton presided at a meeting of the Joint Industrial Council for the Tramways Industry on September 21st. The employers submitted a modified scheme of wages reduction, involving a "cut" of 3s. per week instead of the 12s. originally put forward. They also desired that the whole question of wages and conditions should be submitted to a court of inquiry in November. A national conference of the men's delegates unanimously rejected the new proposals, resolving not to agree to any reduction in wages whatsoever. There appeared to be some difference of opinion regarding the rates to be paid to employés in the Metropolitan area and those outside it. It was felt that a settlement could be arrived at if the two classes were considered separately. On Tuesday last the National Council again met, and, after a long discussion, adjourned until the following day without having arrived at a settlement.

The Sunderland Tramways Committee, which has seceded from the Joint Industrial Council, has submitted a scale of reduced wages to its employés, who have replied that they cannot accept the scale as it stands, nor can they accept any revision of wages which will mean a greater reduction than that which is eventually accepted under the national scale. They ask for an early interview with the Committee. The Committee's scale proposes reductions of varying amounts in the pay of all classes of employés, ranging from 8s. to 13s. a week, the cuts to be made in three instalments. Under it no present employé would receive less than 51s. a week, and newcomers would get not less than 50s. a week. Ticket inspectors' wages would be reduced from 73s. 6d. to 61s., motor inspectors' from 78s. 3d. to 65s.; drivers' from 68s. 6d. to 57s., and conductors' from 62s. 9d. to 53s. The scale is based on the condition that the men agree to a reduction in the annual holiday with pay from eight days to six days.

Brown-Boveri South American Branch.—The *Review of the River Plate* reports the formation of the Brown-Boveri Compañia Sudamericana de Electricidad as follows: "Domicile, city of Buenos Aires with the right to establish branches. Duration, 30 years, with the right to prolong. Object: to exploit the 'Brown-Boveri' processes and patents in South America and more particularly in Argentina, Uruguay, Paraguay, and Peru, by the importation of electrical materials, &c., manufactured in the 'Brown-Boveri' workshops. Capital, $500,000 m/n in 500 shares of $1,000 m/n each. The company has the right to issue debentures. Board of directors: Directors, Atanasio Iturbe, Antonio Chiesa, Juan Carosio, Walter Boveri and Jorge Boner. Directors-alternate: Juan Massone and Ernesto Franzoni. Syndic: William S. Bell. Syndic-alternate: J. Monteith Drysdale. Shares have been subscribed as follows: Juan Carosio, 50; Atanasio Iturbe, 50; Augustin Zamboni, 50; Luis Riva, 50; Oscar Strazzolini, 50; Octavio Cesario, 50; Sebastian L. Flores, 50; Juan Alberto Molinari Calleros, 50; Humberto Ghersa, 50; and Juan B. Rivara, 50. Total, 500 shares."

Australian Tariff Decisions.—The following decisions, *inter alia*, have been approved by the Customs Department: *Scientific Instruments and Apparatus.*—Binaural instruments for the detection and location of sound. Item 174. Free under the British preferential tariff, 5 per cent. under the intermediate tariff, and 10 per cent. under the general tariff. *Electrical Appliances.*—Accumulators having plates 14¾ in. by 13¾ in. "for use in the production and distribution of electricity from brown coal." Item 174. Free, 5 per cent., and 10 per cent. *Machines, machinery, &c.*—Dies, wire drawing. Item 174. Free, 5 per cent., and 10 per cent.—*Reuter's Trade Service* (Melbourne).

A Chilean Experiment.—The U.S. Commercial Attaché at Santiago, in an August dispatch (*Commerce Reports*, September 4th), says that the provision of money for the payment for the electrification and the railway material purchased in the United States last year brought about discussion in Congress, which has resulted in the enforced decision of the railway administration to authorise the construction of locomotives and cars within the country. The result of the experiment of building locomotives in Chile is uncertain, and it is doubtful whether the railway administration will be able to count upon them with sufficient security to avoid purchase abroad in case the services require additional equipment within a comparatively short space of time."

Midland Electrical Notes.—Our Birmingham correspondent writes: "Engineering is making but slow progress in Birmingham and the Midlands. On the electrical side, however, there is a better inquiry for motors adapted to industrial purposes, but the accessory trade is still rather lifeless. For small lighting sets for private houses there is a much better demand. The actual number of orders received for power plants is not large, but the inquiries are more numerous, both on home and foreign account. In the coal mines electricity is having a much wider application, and a certain amount of business under this head has been received from France. The electrical section of the new technical school at Rugby has been completed. The equipment of a very up-to-date kind has been presented by the B.T.H. Co."

South African Tariff.—The South African Customs authorities have recently given a decision to the effect that "switches, dimmer for motor car lamps" are to be classified under No. 114b of the Tariff, the general duty being 3 per cent., British manufactures being admitted free.

Electricity Meters for the Sydney City Council.—With further reference to this matter (see Elec. Rev., September 15th, p. 375) the *Industrial Australian and Mining Standard* for August 10th reports as follows: "The Sydney City Council proposes that the contract already made with the Electricity Meter Manufacturing Co., Ltd., for the supply of 1,500 5-amp. 240-volt single-phase induction house-service meters, be extended to cover the supply of 500 additional meters. The price of the additional meters to be £2 each. The electricity committee considers that the council cannot afford to 'spoon-feed' any longer the meter manufacturing industry in Sydney by paying higher prices for electric meters than those ruling in the open market. It accordingly rejected a proposal by the Electricity Meter Manufacturing Co. to supply 5,000 meters at £2 each, but decided to recommend the acceptance of 500 meters at the price stated above. It is anticipated that the Sydney City Council will be calling for tenders for the supply of 5,000 electricity meters."

Works Visit.—The Electrical Society of Glasgow opened its proceedings for the session on September 19th with a visit to the works of the Falkirk Iron Co., Ltd., at Falkirk. After being entertained to lunch, the party, numbering about 90, proceeded to the works canteen, where successful demonstrations of electric cooking were given on a present-day cooker, and also on a "Model" cooker which the company has evolved. The principal feature of the "Model" cooker is that heat is induced in the bottom and sides of the cooking utensils themselves, and not in the appliance, which remains cool. The utensils are specially made, and as no flames or radiant heat impinge on them they should outlast ordinary cooking vessels. The domestic equipment on which the demonstrations were conducted consisted of one large and one small "Inducer" mounted on a standard cooker, the "Inducers" replacing the ordinary solid or radiant-type boiling plates. It is claimed that the domestic "Inducer" as demonstrated has an efficiency varying from 85 to 90 per cent. One pint of cold water can be boiled in one minute, and 16 pints can be brought to the boil on a consumption of one kWh. With larger quantities of water the "Inducer" boiler is said to be capable of as high an efficiency as 97 per cent. Not only is extremely rapid heating and cooking obtainable, but when once the food or water is brought to the boil the wide range of control permits simmering, braising and other slow operations to be carried out economically. The lowest loading of the smallest "Inducer" is 120 W. After the cookery demonstrations the party was conducted round the various departments of the works, the Electrical Department being of special interest.

E.D.A. Salesmanship Conferences.—The first E.D.A. Salesmanship Conference for the session 1922-23 will take place at Caxton Hall, Westminster, S.W., on Friday, October 13th, at 7.30 p.m. Mr. W. E. Bush (of the B.T.H. Co.) will open a discussion on "Salesmanship in Relation to Lighting," and Mr. Ll. B. Atkinson will take the chair.

Copper and Lead Prices.—Messrs. F. Smith & Co. report September 26th:—Copper (electrolytic) bars, £71 5s., 5s. decrease; do. do. sheets, no change; do. do. wire rods, £81 5s., 5s. decrease; do. do. h.c. wire, no change.

Messrs. James & Shakespeare report September 27th:—No change in copper bars (best selected), sheet and rod, and English pig lead.

Telephone Exports to the Dutch Indies.—The Swedish General Consul at Batavia reports that the Swedish exports of telephone apparatus to the Dutch East Indies now seem to be threatened by the United States and Japan. These two countries entered that market during the time of the war and appear to find a wide field for their manufactures. If Sweden is to maintain its position the Consul states that it will be necessary for suitable measures to be adopted to meet the competition in question.

The Electrification of Russia.—At a conference of the communist party, held in Moscow about a year ago, M. Lenin declared that the "Council Republic is communism plus electrification." Matters now appear to have somewhat changed. The *Isvestija*, the official organ of the All-Russian Executive Central Committee, recently referred to the question of electrification, and stated: "The moneys are not to be found, and consequently the works of electrification, which involve large expenditure, have been discontinued." On the other hand a telegram sent out from Moscow last week announces that the Supreme Economic Council has approved a draft of a decree to authorise the formation of a joint stock company for the financing of works of electrification, which is thought of as an organising and financial centre for these works. The constitution of the company is to take place with the participation of the State Bank and the Bank of Industry, and a foreign agency of the company, under the control of the Foreign Trade Commissariat, is to negotiate the purchase of electrical machinery and materials abroad.

For Sale.—By direction of the Disposal Board, Messrs. Geering & Colyer will sell by auction, on October 12th and the following day, at H.M. Naval Depôt, Dover, and at the Royal Army Ordnance Depôt, Shorncliffe, generating plant, machinery, cranes, machine tools, &c.—Stockport Corporation Electricity Department invites offers for surplus plant, consisting of three 500-kW Bellis generating sets, a number of motors, fan, &c.—Worcester Electricity Department has for disposal six E-type "Underfeed" stokers; Messrs. Jones and Griffiths are inviting offers for surplus generating plant now lying at the power station of the Mardy Electric Light Co., Ltd., Mardy Station, Rhondda Valley. The plant was installed in 1911 by the G. E. Co., Ltd., and is now being sold owing to the change-over from d.c. to a.c. Instructed by the Liquidator, Messrs. S. M. Wilkinson and Co., are inviting offers for the stock, fittings and fixtures of Messrs. Evans, Dewhurst & Colley, Ltd., electrical, mechanical, and motor engineers, of West Wharf, Cardiff. The Yorkshire Electrical Power Co. has for disposal two water-tube boilers, superheaters, and hand-fired furnaces, condensing plant, pumps, &c. (See our advertisement pages to-day.)

LIGHTING AND POWER NOTES.

Aberdeen.—Price Reductions.—The Electricity Committee has reduced the price of electricity by ¼d. per kWh as from July last. The price per kWh will now be as follows:—Private lighting, 5½d.; public lighting, 3¾d.; heating and cooking, 1½d.; and power (lowest rate), 1½d.

Argentina.—Water-Power Development.—The Minister of Public Works of the Province of Mendoza has submitted to the Legislature of that province a gigantic scheme for the exploitation of the water-power which is now going to waste, and which the Minister says can be economically utilised for the generation of electrical energy and the irrigation of 625,000 acres of land. The Government proposes the construction of plant on the River Atual at a point near the town of Nihuil to generate from 40,000 to 100,000 h.p. of electrical energy. Government engineers have pointed out that from Nihuil to Mendoza, a distance of nearly 300 miles, electrical power can easily be conveyed for lighting and industrial purposes. At present the supplying of light and power involves the transport of fuel from Buenos Aires, and to produce 40,000 h.p. by Diesel engines would require a supply of 70,080 tons of crude petroleum per annum. The Minister has asked the Legislature to pass a law authorising the calling of tenders for a concession to be granted for the installation and operation of the hydro-electric plant at Nihuil, notification to be given in all foreign countries, with a term of six months for the submission of offers. Full details of the project can be obtained from the Minister of Public Works, City of Mendoza, Argentina.—*Reuter's Trade Service* (Buenos Aires).

Australia.—Manly (Sydney).—The Council is to borrow £25,000 for extending its electric street lighting and mains. —*Reuter's Trade Service* (Melbourne).

Bangor.—Electricity Scheme.—The Urban Council has under consideration a scheme for supplying the district with electricity. The estimated cost of carrying out the work is £33,300.

Barnes.—Proposed New Plant.—Last year a proposal to install an additional turbo-alternator, with the necessary converting plant, was deferred owing to the excessive cost. The engineer has now reported that the additions are urgently needed, and he has therefore been instructed to prepare estimates for the plant.

Bedford.—Application for Order.—The Town Council has applied to the Electricity Commissioners for a Special Order extending the area of supply to the parishes of Kempston, Wootton, Stagsden, Biddenham, Bromham, Pavenham, Oakley, Clapham, Milton Ernest, Revensden, Wilden, Renhold, Goddington, Willington, Cople, Cardington, Eastcotts, Wilshamstead, and Elstow.

Bo'ness.—Transfer of Undertaking.—At a recent meeting of the Town Council it was agreed to take over, as from July next, the control and management of the town electricity undertaking, which 20 years ago was leased to the National Electric Construction Co., Ltd. The capital expended on the works to date is £59,000, and the amount outstanding £42,000.

Canada. — Newfoundland. — According to Washington officials of the Newfoundland Business Men's Committee, the Premier (Sir Richard Squires) is now in London negotiating for British support for the 235,000 h.p. electrical plant which is to be installed on the Humber River, Newfoundland.—*Westminster Gazette.*

Cardiff.—Price Reductions.—The Electricity Committee has recommended the following reductions in the charges for electricity: Lighting, from 6¼d. to 5¼d. per kWh; power, from 2¾d. to 2¾d. per kWh; heating and cooking 1¼d. per kWh during the winter quarters, and 1¼d. per kWh for the summer quarters.

Carlisle.—Year's Working.—The report of the City electrical engineer (Mr. C. W. Salt) for the year ended March 31st, 1922, states that the total revenue of the electricity undertaking was £53,470, as compared with £54,618 in the previous year. The total working expenditure fell from £41,492 to £38,533, increasing the gross surplus from £13,126 to £14,937. Capital charges increased from £12,692 to £14,358, leaving a net profit of £579, as compared with £455 in 1920-21. The amount of energy sold decreased from 6,220,535 to 5,886,680 kWh. The capital expenditure during the year was £14,938.

Continental.—Bulgaria.—*Water Power.*—A report upon the hydro-electric resources of Bulgaria by the U.S. Vice-Consul at Sofia was recently published in *Commerce Reports*. It is stated that the estimated potential water-power amounts to over a million electrical horse-power. According to projects recently planned for its utilisation only about 150,000 h.p. would be required primarily for the electrification of the railways and industries, leaving the remainder for lighting and agricultural purposes. A programme drawn up by the State proposes the construction of a number of hydro-electric stations, interconnected with transmission lines throughout the country. The State recognises the necessity for the aid of foreign construction companies in order to obtain the full benefit of their superior technical knowledge, construction methods, and equipment. To this end all work to be undertaken will be publicly advertised.

The preliminary estimate of the cost of the State project amounts to 260,000,000 leva (£1=700-750 leva, August 22nd).

Crieff.—Electricity Supply.—The Town Council is to transfer the scheme for the introduction of electricity to a local company to be named "The Crieff Electric Supply Co.," cancel the Special Order already obtained by the Council, and co-operate with Edmundson's Electricity Corporation, Ltd., in carrying out the scheme.

Edinburgh.—Progress of the Portobello Station.—The three 10,000-kW turbo-alternators, with their condensers, air pumps, and auxiliary plant, at the new Portobello power station, are now complete, with the exception of a small amount of pipework. Two of the boilers are practically finished, and a third will probably be ready by November. It is anticipated that this will be sufficient to meet this winter's demand.

Glasgow.—Elfctricity Extensions.—It is recommended that permission be granted to the Clyde Valley Electrical Power Co. to carry out the necessary mains extensions for the purpose of giving a supply of electricity to the Tollcross housing area, the nearest cable belonging to the Corporation being two miles distant.

Hereford.—Result of Inquiry.—The *Bath Chronicle* states that disquieting disclosures are the result of an inquiry by a special committee of the City Council into the financial position of the Corporation's Electricity Committee. Hereford was the first municipality in this country to establish a scheme for supplying electricity to towns and villages within 20 miles, and in three years the Council has spent over £100,000. It was stated at the inquiry that of that amount £10,000 could not be accounted for, and that one firm was paid £900 commission on poles supplied by another firm.

Hove and Aldrington.—Year's Working.—The report on the working of the Hove electricity undertaking for the year ended March 31st last, shows a total revenue of £45,007, as compared with £39,703 in the previous year. Working expenses amounted to £26,107, leaving a gross profit of £18,900. After payment of capital charges there was a net profit of £6,049. In the previous year there was a surplus of £2,959. The number of kWh sold increased from 1,290,504 to 1,456,861. A total of £17,752 was spent during the year on capital account; this included machinery, £7,125; mains, £1,531; bulk supply mains, £7,320; and meters, £1,177. The Electricity Committee has recommended a reduction of 1d. per kWh in the charge for electricity for lighting purposes, beginning from the September quarter's readings.

The working of the Aldrington electricity undertaking for the past year shows a total income of £4,170. Working expenses absorbed £2,611, leaving a gross profit of £1,459. After meeting capital charges, &c., there was a net profit of £339, as compared with £34 in the previous year. The number of kWh sold rose from 112,784 to 129,913 .

Keith (N.B.).—Electricity Scheme Abandoned.—The Town Council has decided not to proceed with the institution of an electricity supply for the district, and the special committee formed for the purpose has been discharged. Messrs. Edmundson's Electricity Corporation, Ltd., had offered to form a company, provided that £5,000 or more was subscribed by residents.

New Zealand.—Devonport.—The Borough Council has under consideration the raising of a loan of £40,000 in connection with the supplying of electricity to the town. The amount would be expended in the following manner: Purchase of present installation, £25,000; alterations to existing mains, £3,000; alterations to plant at pumping station, £2,000; installation of new plant, £10,000. A report prepared by the Council's consulting engineer states that a profit of £5,000 per annum could be expected without any increase of existing rates.

Ashburton.—The poll in connection with a loan of £296,500 to provide for the installation of electric light and power in the district has resulted in a large majority favourable to the proposal.—*Reuter's Trade Service* (Melbourne).

South-East Lancashire District.—Electricity Advisory Board.—The South-East Lancashire Electricity Board, at a meeting on September 19th, approved proposed contracts for bulk supplies from the Lancashire Electric Power Co. to Radcliffe Urban District Council and Rochdale Corporation, and from the Manchester Corporation to the Lancashire Electric Power Co.; and also the construction of certain mains in connection with such supplies. The Board is in operation in all respects as though the Order had been approved by Parliament, and has prescribed forms in order to standardise procedure in relation to the submission of material facts by constituent authorities in connection with their proposals. The Board has also instructed the Engineering Advisory Committee to consider and report upon the adjustment of running hours of the generating stations in such manner as to effect the maximum economy in the production of electricity; and the principles which should govern the charges to be made for reciprocal stand-by and bulk supplies. The Board has recommended the Electricity Commissioners to amend the Order so as to provide for the addition to the Engineering Advisory Committee of a member representing the distributing authorities, and in anticipation of this amendment the distributing authorities have appointed Mr. H. C. Busbridge, the engineer to the Swinton and Pendlebury Urban District Council.

Winchester. — Year's Working.—The accounts of the municipal electricity undertaking (engineer: Mr. L. Ayton) for the year 1921-22 show a total revenue of £30,458, as compared with £33,563 in the previous year. The working expenditure totalled £22,497, as against £25,147, leaving a gross balance of £7,961 (£8,416). After payment of interest, sinking fund, and other charges, a balance of £1,047 was carried forward; this was slightly greater than the equivalent figure in the previous year—£1,022. The expenditure on capital account during the year was £12,759, the principal item being £10,314 for machinery. The total energy sold increased from 1,407,814 to 1,493,161 kWh. The report states that the new turbo-generator set was not delivered until September last, and consequently was only in service from November onwards. The two Belliss-Parker sets were sold for £1,250, which was £250 above their estimated value.

Wolverhampton.—Year's Working.—The report of the Electricity Committee upon the undertaking (engineer: Mr. S. T. Allen) for the year 1921-22, records a total revenue from all sources of £164,552, as compared with £193,369 in the previous year. Working expenses amounted to £94,777, as against £119,932, leaving a gross profit of £69,775 (£73,437). Against this was charged an amount of £55,973, including £5,000 transferred to the Improvement Fund, giving a net profit of £13,941, the whole of which was transferred to the Reserve Fund. Last year there was a profit of £27,064. The Reserve Fund now stands at £63,929. The capital account shows an expenditure of £41,105 during the year, the principal items being £31,765 expended upon mains and services, and £8,619 for transformers. The amount of energy sold underwent a serious decrease, *viz.*, from 21,559,351 to 16,208,656 kWh, providing yet another proof of the bad state of industry during the year.

Scheme for Unemployed.—In order to provide work for the unemployed during the winter a scheme has been submitted to the Unemployed Grants Committee for laying mains, &c., at a cost of £8,700.

St. Helens.—Year's Working.—The total revenue of the electricity undertaking for the year ended March 31st last was £87,629, as compared with £121,515 in 1920-21. Working expenses were £62,579, as against £100,233, leaving a gross profit of £25,050 (£21,282). After the payment of capital charges and the crediting of various amounts, including £3,862 brought forward from the previous year, the sum of £4,888 was carried forward. During the year the sum of £50,506 was spent on capital account; this included £16,560 for machinery, £15,081 for sub-station buildings and equipment, and £12,614 for mains and services. A total of 13,187,606 kWh of energy was sold, a decline of over 8,000,000 on the previous year's figure.

Warrington.—Year's Working.—The accounts of the Corporation electricity supply undertaking (engineer: Mr. F. V. L. Mathias) show that the income during the year ended March 31st last amounted to £103,054, as compared with £123,365 in the preceding period. The total amount of working expenses was £65,239, as against £92,211; this reduction was due mainly to a fall in generation costs from £63,520 to £41,765. The gross surplus was thus £37,815, as compared with £31,153 in 1920-21. After crediting interest on investments and deducting capital charges, a net profit of £11,215 remained; this compared with £12,037 in the previous year. The capital expenditure during the year was £49,490, "machinery, tools, &c.," accounting for £30,428, and mains and services for £10,525. In common with the majority of undertakings there was a decline in the amount of energy sold—from 9,681,226 to 8,019,814 kWh. The capacity of the plant remained at 7,750 kW.

York.—New Hydro-Electric Station.—It is stated in the Yorkshire Press that the hydro-electric station at Linton Lock is expected to be in operation before next Christmas. The installation will consist of three turbines, two of 560 b.h.p. and one of 410 b.h.p., driving 6,000-V alternators through gearing. The power will be transmitted a distance of 10 miles to a sub-station at Lendal Bridge, York, at the generated voltage; it will there be transformed and converted into d.c. at 230 V. The total cost of the scheme will be between sixty and seventy thousand pounds, and it is estimated that a saving of 4,000 tons of coal per annum will be effected.

TRAMWAY AND RAILWAY NOTES.

Australia.—New South Wales.—The Sydney *Sun* states that while it has been decided that the Bankstown line shall be the first to be electrified, even this is a long way off. There seems little prospect at present of the Treasury providing the money for the work. The electrification of the North Shore line lies in the still remoter distance. The Commissioners have long been urging the electrification of the Newcastle steam tramways, which are losing £40,000 a year through the competition of the 'buses. No money, however, can be found for this work, though it is claimed that it would be highly remunerative.

Birmingham.—Proposed New Route.—The City Council has under consideration a number of winter relief schemes for providing work for the unemployed. It is proposed to spend £776,000; this amount will include £187,700 for the construction of a tramway track to Rubery and Rednal, villages on the Worcestershire side of the city.

Bradford.—Year's Working.—The report of the general manager of the Corporation tramways (Mr. R. H. Wilkinson) for the year ended March 31st, 1922, shows a total combined revenue (general, railless, and parcels) of £721,547, as compared with £718,539 in the previous year. The working expenses totalled £588,803, as against £653,903, leaving a gross surplus of £132,744 (£64,636). This was made up of a surplus on general account of £143,388 and deficits of £8,068 upon the railless traction account, and of £2,576 upon the parcels account. Capital charges, &c., absorbed £76,128, giving a final result of £56,616 profit, as compared with a net deficit of £16,434 in 1920-21. The increased revenue was due to the higher scale of fares, with a 2d. minimum, put into operation in October, 1920. The receipts per car-mile were 28.440d., as compared with 27.292d. in the previous year. The working expenses were reduced from 23.493d. to 22.088d. per car-mile. The car-mileage was 6,132,403, a decrease of 215,001. The route mileage of the tramways operated by the Corporation is now 59 miles, or 109 miles of single track. The railless trolley routes have a total length of 9½ miles, and further extensions are contemplated in the near future.

Continental.—Spain.—A concession for the construction and working of an electric tramway in Pontevedra has been granted to Don Teodosio Dominguez.

The Sociedad Anonima Ferrocarril Metropolitano de Barcelona (Barcelona Underground Railway) has concluded an agreement with the Town Council to accord the latter a share in its profits, to pay a yearly fee and satisfy all the requirements of the municipality. The network of this second underground company in Barcelona will cross the city from north to south, and the company undertakes to build an underground line starting from Bollblanch and ending at San Andrés. From this line a branch will be made to the grounds of the electrical exhibition, which is to be held in 1924. The Collblanch-San Andrés line will be completed in 18 months, and the total cost is estimated at 30,000,000 pesetas. To further the construction of the Exhibition of Electrical Industries the Town Council has sanctioned the borrowing of 70,000,000 pesetas.

Active progress is being made with the equipment of Madrid with an underground electric railway service. By 1924 the Compânia Metropolitano Alfonso XIII. will have completed the Sol to Ventas line, which will give 4 km. of extensions, with eight new stations. Other extensions are under way or in contemplation. Foreseeing that the supply of current from existing sources may not cover its future needs, the company has begun the erection of a large steam-driven generating station in the Calle Pacifico, which is expected to be working by the summer of 1923.

According to the *Westminster Gazette*, a scheme for the electrification of 10,000 kilometres of Spanish railways by utilising waterfalls, at a cost of 1,400,000,000 pesetas, is under discussion.

Italy.—The Società Anonima delle Ferrovie Economidre de Bruxelles has secured authorisation to electrify the Biello to Mongrando railway. The line is 8,185 km. in length.

Edinburgh.—New Route.—The Corporation is to extend the tramways from Murrayfield terminus to Corstorphine at a cost of £43,000.

Glasgow.—Purchase of Paisley Undertaking.—In connection with the proposed acquisition by the Corporation of the Paisley tramways, the Town Council has agreed that £18,000 be paid to Paisley Corporation as compensation for the loss of revenue from electric energy supplied to the tramways.

India.—Railway Electrification.—The *Railway Gazette* states that the Indian Government has now sanctioned the electrification of a large portion of the Bombay suburban lines of the Great Indian Peninsula Railway and tenders for the necessary plant will be called for at an early date. The portion to be electrified includes the Great Indian Peninsula local lines from Victoria terminus to Thana and the harbour branch which runs through Sewri to join the main line at Kurla. It also includes the Mahim Chord branch connecting up to Mahim on the Bombay, Baroda & Central India Railway. The latter branch will enable passengers from the residential districts around Bandra to travel direct to Victoria terminus. The next step of the Government in this direction will no doubt be to sanction the similar electrification which is proposed on the Bombay, Baroda & Central India suburban line. The overcrowding to be seen at present on the suburban trains of this railway is evidence that the fast and frequent service which electrification would provide is much overdue. It is hoped that the first portion of the new electrified service on the Great Indian Peninsula Railway will be in operation before the end of 1923. The total expenditure will probably reach two millions sterling apart from the electrification of the ghâts line, which will probably be carried out subsequently.

Bombay.—The employés of the tramway undertaking are on strike. It is stated that the strike was due to the non-recognition of their union.

London.—Forecast of Reduced Fares.—The *Westminster Gazette* stated last week that reductions in the fares charged by the "Underground" companies are imminent, as the Railway Rates Advisory Committee has the matter in hand. The same journal also stated that "the main-line companies are to reduce ordinary passenger fares shortly by 25 per cent. on present rates."

Electric Railway Extension.—*Modern Transport* states that tenders will shortly be invited for the extension of the Metropolitan and Great Central Joint Railway from Rickmansworth to Watford. It is the intention ultimately to electrify the line throughout from Harrow to Watford; the present express services of the Metropolitan Railway will then be extended to afford through fast trains to the City *via* the Inner Circle line.

Report on Collision.—The report of Col. J. W. Pringle to the Minister of Transport, upon the collision on July 12th between an electric train and a buffer stop at the Ealing Broadway (G.W.R.) station, has been published. The train, which weighed about 119 tons, was fitted throughout with a Westinghouse air brake; the single buffer stop had a 17-in.-diameter piston with an 8-ft. stroke, and was calculated to offer resistance sufficient to withstand the thrust of a 200-ton train moving at a speed of 10 m.p.h. In this instance the hydraulic (oil) ram was pushed in 5 ft. 9 in. Two qualified drivers were in the motor cab, and the continuity of the brake had been tested and found satisfactory; the brake had been employed in pulling up the train at the previous station. The driver stated that he cut off the current at the proper place when the train was travelling at about 30 m.p.h. When the speed had fallen to 20 m.p.h. he applied the brake, and he thought—although he was not certain—that the too-rapid deceleration made him release the brake. When he re-applied it the brake did not give the expected effect, and so he made a third application while passing the station platform. He then made an emergency application of the brake, which

caused the train to skid and collide with the buffer stop. The driver admitted that the accident was due to his bad manipulation of the brake.

"Underground" Extensions.—*The Times* states that it is hoped to be able to run through trains from Edgware to Moorgate by October 1st next year, but that the through service from Edgware to Clapham Common is not expected to be commenced for at least two years. The enlarging of the City and South London tube is causing surprisingly little inconvenience to passengers. The extension of the Hampstead line from Golder's Green to Edgware is well advanced, and it is hoped that this section will be open to traffic by October 1st, 1923.

Newcastle-on-Tyne.—Year's Working.—The annual report of Mr. Ernest Hatton, engineer and general manager of the Corporation's electricity and transport undertaking, shows that while the year ended March 31st last finished with a debit balance of £2,667, the reserve fund had also been practically wiped out, the balance remaining being only £946. Mr. Hatton draws attention to the fact that the stoppage in the mining industry had materially affected the undertaking, involving considerable expense in providing oil fuel plant, as well as the oil fuel itself. The strike of the tram-workers on the 48-hours' question in February and March also cost the department some £13,000. The financial statement in the report shows a total revenue of £546,818, compared with £580,268 in the previous year. Working expenses were £467,735, against 498,966 in the previous year. The gross profit was £79,083, to which was added interest on investments £2,810, making a total of £81,893 available. Of this sum £28,431 was absorbed by interest on capital, and £42,555 for redemption of debt; other smaller items reduced the balance to £7,253; income tax required £9,920, causing a deficit of £2,667. The gross capital expenditure on the undertaking has reached £1,611,921. The traffic revenue per car-mile was 22.65d., and the total operating costs per car-mile 19.508d.

Reading.—Extension of Time.—The Minister of Transport has extended the time of the Corporation Act for the completion of the tramways until July, 1924.

South Shields.—Year's Working.—The annual report on the working of the tramway undertaking for the past year shows a total revenue of £89,533 as compared with £102,085 in the previous year. Working expenses amounted to £84,581 (£98,707) leaving a gross profit of £4,952. After deducting capital charges there was a deficit of £8,686. The number of passengers carried decreased from 18,115,530 to 15,195,139, and the total number of car-miles run rose from 1,140,137 to 1,142,131. This is the first year in which the receipts have shown a decrease.

Warrington.—Proposed Track Renewals.—The Town Council has under consideration a proposal to expend £16,000 for the reconstruction of the tramway track in Liverpool Road, and the relaying of the section between Pickmere Street and Atherton's Quay.

Wolverhampton.—Track Renewals.—It is proposed, in order to provide work for the unemployed, to relay certain portions of the tramway track at a cost of £56,685.

TELEGRAPH AND TELEPHONE NOTES.

Austria.—Marconi Concession Ratified.—The Reparations Commission, having ratified the Austrian Government's concession to Marconi's Wireless Telegraph Co., the final documents relating to that concession have been signed and are now in London. By this concession the Marconi Co. is given the sole right to erect, and to work for 30 years, wireless stations for public traffic between Austria and all other countries.

Brazil.—Telephone Concession.—The Brazilian Traction, Light & Power Co. has been granted a concession in connection with telephone services in the Federal district by the Rio de Janeiro Municipal Council. Among the improvements embodied in the contract is permission to vary charges in accordance with the rate of sterling exchange. Revisions may be made at intervals of four years.

China.—Proposed Agreement.—It is proposed to come to an agreement with the Chinese Government as to the disposition of the radio stations at Tsingtau and Tsinan and to arrange for the continued operation of the submarine cables between Tsingtau and Sasebo. These two units were part of the communication system developed and administered by the Germans and taken over by the Japanese during the war.—*T. & T. Age.*

Germany.—"Broadcasting" Service.—A public "broadcasting" service has been instituted by the State for the dissemination of market reports and other commercial news. It is considered that this will relieve the congestion on the telephone and telegraph services to a great extent. The receiving apparatus is installed and maintained at an annual fee. It is proposed to inaugurate a lecture, concert, &c., "broadcasting" scheme shortly.

Italy.—New Cables.—The Ministry of Posts and Telegraphs is undertaking some extensive repairs in telegraphic communications between Sicily and the mainland. In addition, two new submarine cables are to be laid between Messina and Catania, and between Catania and Syracuse.—*Commerce Reports.*

Sweden.—New Radio Station.—Competing with the English, French, and Germans, the Americans were successful, according to a message received on August 22nd from E. F. W. Alexanderson, chief engineer of the Radio Corporation of America, in securing a contract with the Swedish Government for furnishing apparatus for a high-power radio station to handle direct wireless communications between the United States and Sweden. The total cost of the station erected will probably be over $2,000,000.—*T. & T. Age.*

The Telegraph Service.—Anglo-Irish Cables Cut.—On September 22nd the cables between Dublin and England were cut at the Dublin end, but were restored by September 25th.

The Telephone Service.—The work of placing the London-Glasgow telephone line underground is proceeding rapidly. Over 150 miles of roadway north of Leeds has been opened up and 50 miles has been relaid. "Spur" cables from Edinburgh, Leicester, Leeds, Newcastle, and Derby are in course of installation to connect up with the main system.

New Exchanges.—Two new exchanges were put into commission on September 23rd. The first, at Wallington, is a 480-line exchange, and 174 lines have been transferred to it from Sutton and Croydon. The other exchange, at Aldershot Post Office, is a c.b. system taking the place of the old magneto equipment. The exchange has 40 per cent. greater capacity than the equipment it replaces, and it is to be considerably extended.

Extension of the "Toll" System.—A wide extension of the "toll" system of dealing with calls from London to outer districts is about to be put into operation. The extended area embraces a further 89 towns, including Brighton, Guildford, Chelmsford, and Tonbridge.

United States.—Wireless Agreement.—The circumstances affecting two of the large land line companies in the United States, which tended to limit direct radio service from America to points on the Atlantic seaboard, have now been rectified by the conclusion of a contract between the Radio Corporation and the land wire system, by which the corporation's radio service to and from America is made available to every city, town and village in the United States.—*Reuter.*

Uruguay.—Montevideo.—The Montevideo correspondent of *The Times* states that the services of the Montevideo Telephone Co. are being interrupted by a strike. The Municipal Council by three votes to two has decreed that the company must cease operations, alleging lack of concessionary rights. The National Administrative Council considers this decision illegal, and has suspended the enforcement of the municipal decree. Congress will be asked to decide the dispute.

Wireless Telegraphy.—The Postmaster-General has suspended the issue of licences for wireless receiving sets pending the settlement of arrangements between the companies which are to carry out "broadcasting" and the Postmaster-General. The latter denies that the companies will be given a monopoly of the sale of apparatus, but it is certain that the companies will have to recoup the large expenditure which they are making on the broadcasting stations, new plant, &c.

The Marconi Experimental Station at Towyn (Merionethshire) was flooded on September 23rd owing to the washing away of the river bank. The operators were forced to carry out their duties by the use of boats.

Wireless Telephony.—The Radio Commmunication Co., Ltd., recently applied to the Barnes Council for permission to erect a lattice-girder wireless mast 100 ft. in height upon land in front of its works, but, upon the recommendation of its Highways Committee, the Council refused to sanction this.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Australia.—Melbourne.—January 31st. Victorian Electricity Commissioners. Back-pressure steam turbine, driving a 1,500-kW turbo-alternator (Spec. 308), four water-tube boilers and accessories (Spec. 317). (September 22nd.)

Perth (W.A.).—November 15th. Postmaster-General's Department. 1,490 galvanised tubular poles.*

Queensland (Mackay).—January 31st, 1923. Boiler and generating plant, switchboard, and transformers. Messrs. Frew & Bridger, Queen Street, Brisbane, are the consulting engineers.—*Reuter's Trade Service* (Melbourne).

Barton-upon-Irwell.—October 3rd. Board of Guardians. Electric lift at the Union infirmary, Green Lane, Patricroft. Mr. P. Howard, architect, 88, Mosley Street, Manchester.

Belgium.—Schaerbeek, Brussels.—October 5th. Municipal authorities. Supply of 525 electricity meters. Service de l'Electricité, Hotel Communal, Schaerbeek.

Bure, Namur.—October 28th. Municipal authorities. Installation of a system of electric lighting and power supply in the town.

Birkenhead.—October 6th. Mersey Railway Co. Electrical sundries. Mr. J. Shaw, general manager and secretary, Central Station, Birkenhead.

Brazil.—Cachoeira, Rio Grande do Sul.—October 24th. Municipal Council. Six centrifugal pumps, with electric motors, piping, &c.*

Edinburgh.—October 17th. Tramways Department. 80 trucks, electrical equipment of cars, &c. Forms from manager.

Egypt.—November 15th. Installation work in connection with a power station and distribution system at Manfalout. Director of Technical Service, Section of Municipalities and Local Commissions, Savoy House, Cairo.

Hawarden.—October 4th. Board of Guardians. Supply and erection of an electric generating set, and also for wiring for electric lighting the Institution at Broughton. (September 22nd.)

Latvia.—Riga.—October 6th. Ministry of Communications. Telephone material, including commutators, portable field telephones, Leclanché cells, and accessories.*

New Zealand.—Auckland.—Twelve 5-ton (and alternatively 3-ton) electric quay cranes. Four 5-ton (and alternatively 3-ton) electric roof cranes. Six 1-ton electric mono-rail cranes. Specifications from Messrs. W. & A. McArthur, Ltd., 18-19, Silk Street, E.C.

Invercargill.—December 15th. Southland Electric Power Board. Turbines and valves, generators, exciters, and battery equipment, steel penstocks and valves, switchboards, switchgear and cables, for the Monswai hydro-electric development scheme. Mr. W. Hinchey, chairman, Southland Electric Power Board, P.O. Box 121, Invercargill, N.Z.

Wellington.—November 21st. Public Works Department. Mangahao scheme. Electrical storage battery and accessories, including a motor-booster and one single-phase testing transformer.*

November 28th. Outdoor and indoor sub-station switchgear in connection with the Mangahao power scheme.*

January 9th, 1923. One electric travelling crane (capacity 27 tons) for the Waikato power scheme.*

Carterton.—November 25th. Wairarara Power Board. Hydro-generating plant and steel pipe line.—*Reuter's Trade Service* (Melbourne).

Nottingham.—October 27th. Electricity Department. Two 650-kVA, 3-phase static transformers, two 900-kVA, 6-phase do., one 150 kVA, single-phase do., three steam-driven turbine boiler-feed pumps, four gravity bucket coal conveyors with crushers, accumulators, &c. (See this issue.)

Portsmouth.—Electricity Supply Department. One 4,000-kW turbo-alternator, with condensing plant, one water-tube boiler (30,000 lb. per hour capacity), with steel bunker and economiser. (See this issue.)

Rosslynlee, Midlothian, and Peebles District Asylum.—Electric fittings, &c., for six months. The clerk, 19, Heriot Row, Edinburgh.

Uruguay.—Monte Video.—November 11th. State Electricity Department. One 10,000-kW turbo-generator. State Electricity Department, Calle Julio Herrera, 1458, Monte Video.*

October 3rd. 10,000 metres 3 mm² rubber insulated cable.

October 4th. 80,000 metres 10 mm², 30,000 metres 20 mm², 25,000 metres 25 mm² paper-insulated cable.*

October 6th. 15,000 metres 2 x .75 mm² rubber-insulated cords for interior use.*

October 9th. 18,600 metres v.i.r lead-covered cable, various sizes.*

October 31st. Switchgear for 15 transformer sub-stations.*

November 21st. 15,000 metres 3 x 32 mm², 36,000 metres 3 x 64 mm², 15,000 metres 3 x 80 mm², 3-ph., h.p. cable; 450 junction boxes; 350 vertical end boxes.*

*A copy of the plan, specification, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Aylesbury.—Town Council. Accepted:—
Illuminated signs (£4 3s. 6d. each).—Edison Swan Electric Co., Ltd.
Wiring, &c., houses for electric light (£164).—G. C. Gowan.

Brazil.—Central Railway Electrification Award.—According to *The Times*, the Brazilian Minister of Transport has advised the director of the Central of Brazil State Railway that the best terms, having regard to price and technical advantages, for the electrification of the Central Railway, are offered by the General Electric Co. (America), and authorising the execution of a formal contract. The total value of the contract is about £2,000,000. Offers were received from the General Electric Co. (American), the Metropolitan-Vickers Electrical Co. (British), and the Westinghouse Co. (American).

France.—Paris.—According to *Reuter*, forty-five tenders have been received for the installation of moving platforms in the Paris underground stations, including quotations from Great Britain, the United States, and Belgium.

Dundee.—Electricity Committee. Accepted:—750 yd. l.p. cable (£668), Union Cable Co., Ltd. The lowest foreign tender received was £689 from a Danish firm.

Glasgow.—Tramways Committee. Accepted:—
Trolley wire.—Thos. Bolton & Sons, Ltd.
M.s. plates for welding.—Steel Co. of Scotland, Ltd.
Insulated bolts.—Fleming, Birkby & Goodall, Ltd.
V.i.r. cable.—Johnson & Phillips, Ltd.
Lead-covered cable.—Western Electric Co., Ltd.
Iron castings (section pillars).—McDowall, Steven & Co., Ltd.

Government Contracts.—The following Government contracts were placed during August, 1922:—

Admiralty Contract and Purchase Department.
L.p. cable.—Johnson & Phillips, Ltd.
Electric overhead travelling cranes.—Cowans, Sheldon & Co., Ltd.
Electric light and power installation.—G. E. Taylor & Co.
Generating sets.—A. G. Mumford, Ltd.
Porcelain insulators.—Bullers, Ltd.; Electric & Ordnance Accessories Co., Ltd.; Taylor, Tunnicliffe & Co., Ltd.

War Office.
Secondary batteries.—Chloride Electrical Co., Ltd.

Air Ministry, Contracts Department.
Electrical fittings (term contract).—General Electric Co., Ltd.; Cable Accessories Co., Ltd.
Electric lamps (term contract).—Notable Electric Co., Ltd.; Cryselco, Ltd.; Edison Swan Electric Co., Ltd.
Thompson Bennett magnetos and spares.—Lucas Electrical Co., Ltd.
W.T. transformers.—Ferranti, Ltd.
W.T. valves.—General Electric Co., Ltd.; Mullard Radio Valve Co., Ltd.

Crown Agents for the Colonies.
Auto-transformer kiosks.—British Insulated & Helsby Cables, Ltd.
Aerial telephone cable.—Callender's Cable & Construction Co., Ltd.
Lighting supplies.—J. Stone & Co., Ltd.
Electricity meters.—Ferranti, Ltd.
Waterworks pumping equipment.—General Electric Co., Ltd.

General Post Office.
Testing and protective equipment.—British L.M. Ericsson Manufacturing Co., Ltd.
Telephone apparatus.—British L.M. Ericsson Manufacturing Co., Ltd.; General Electric Co., Ltd. (Peel-Conner Telephone Works); Phœnix Telephone and Electric Works, Ltd.
Telegraph and telephone cable.—Enfield Ediswan Cable Co., Ltd.; Hackbridge Cable Co., Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Compound.—Dussek Bros. & Co., Ltd.
Switchboard cords.—Phœnix Telephone & Electric Works, Ltd.; British Insulated & Helsby Cables, Ltd.
Joint box covers.—United Steel Companies, Ltd.
Ducts.—Albion Clay Co., Ltd.; Donington Sanitary Pipe & Firebrick Co., Ltd.; Doulton & Co., Ltd.; Stanley Bros., Ltd.; Sutton & Co. (Overseal), Ltd.; J. Woodward, Ltd.
H.d. copper wire.—R. Johnson, Clapham & Morris, Ltd.
Manufacture, drawing-in, and jointing cable.—Coventry-Leicester: Johnson & Phillips, Ltd.
Laying conduits.—A large number of contracts for this service have been placed during the month.
Telephone exchange equipment.—Marton: Automatic Telephone Manufacturing Co., Ltd.; sub-contractors for batteries, Chloride Electric Co., Ltd. L.C.C. County Hall: Automatic Telegraph Manufacturing Co., Ltd.; sub-contractors for batteries, Tudor Accumulator Co., Ltd. Walton (Liverpool): Western Electric Co., Ltd.; sub-contractors for batteries, Tudor Accumulator Co., Ltd.; for charging machines, Electric Construction Co., Ltd.

H.M. Office of Works.
Engineering services.—Electric wiring Natural History Museum: Alpha Manufacturing Co., Ltd.

Holmfirth.—Urban Council. Accepted:—
Alterations to the plant at the electricity works (£3,160).—Johnson and Phillips, Ltd.

London.—Hackney.—Works and Open Spaces Committee.

Electric vehicles for dust collection:—	Per Vehicle.
Clayton Wagons, Ltd.—Battery—Chloride IMV 10, 44 cells, 323 amp. hours	£770
Elite Electric Vehicles, Ltd.—Battery—Tudor 80 cells, 250 amp. hours	825
Electromobile, Ltd.—Battery—Chloride IMV 10	868
Electricars, Ltd., Seymour Place, W.1.—Battery—Edison A.8, 60 cells, 70 volts, 300 amp. hours	1,526
Battery—Edison, 60 cells, 375 amp. hours	1,276
Garrett & Sons, Ltd.—Battery—Chloride, IMV 9, 44 cells, 293 amp. hours (recommended)	**750**
Battery—D.P. lead acid, 44 cells, 300 amp. hours	732
Battery—Ni. Fe. nickel iron, 60 cells, 380 amp. hours	1,041
Battery—Edison, 60 cells, 375 amp. hours	1,276
Ransomes, Sims & Jefferies, Ltd.—Battery—Chloride, IMV 9, 40 cells, 290 amp. hours	780
Battery—Ni. Fe., 60 cells	1,252
Battery—Edison, 60 cells A10, 375 amp. hours	1,607
Newton Bros. (Derby), Ltd.—Battery—Chloride, 44 cells, 290 amp. hours	914
General Vehicle Co., Ltd.—Battery—G.V. 10, 44 cells, 300 amp. hours	750
General Electro-Motives, Ltd.—Battery—Chloride, IMV 10, 42 cells, 325 amp. hours	986

The Committee recommends that, subject to the L.C.C. sanctioning the necessary loan, the tender of Messrs. Garrett & Sons, Ltd., be accepted

for 20 electric house-refuse vehicles, with Chloride batteries, at £750 each, provided the firm undertakes to supply a further three vehicles, if required, at the same price or such lower price as may be ruling at the date the order is given.

Battersea.—Electricity Undertaking Committee. Recommended:—

Air-cooling plant for No. 2 turbo-generator set (£964).—Fraser & Chalmers, Ltd.

The following contracts to be renewed for six months:—

Cables.—Callender's Cable and Construction Co., Ltd.
Electricity meters.—Chamberlain & Hookham, Ltd., and Ferranti, Ltd.
Electrolytic meters.—Reason Manufacturing Co., Ltd.
Engine room stores.—Pryke & Palmer, Ltd.

St. Marylebone.—Electric Supply Committee. Recommended:—Renewal of contracts for house service meters for 12 months, with Chamberlain & Hookham, Ltd., and Ferranti, Ltd.

Lanark.—Messrs. Martin & McGregor, Wishaw, have secured the contract for electric tubing in connection with new offices for the County Council at Lanark.

FORTHCOMING EVENTS.

Society of Engineers.—Monday, October 2nd. At Burlington House, Piccadilly, W. At 5.30 p.m. Paper on "The Economics of Arterial Land Drainage," by Mr. C. H. J. Clayton.

Housing and Health Exhibition.—October 2nd to 21st. At the Kelvin Hall, Glasgow.

Swansea Electrical Exhibition.—October 2nd to 14th. At the Drill Hall, Swansea.

Institute of Transport.—Monday, October 2nd. At the Institution of Electrical Engineers, Victoria Embankment, W.C.2. At 5.30 p.m. Annual general meeting, presidential address by Sir Sam Fay.

Institution of Railway Signal Engineers.—Wednesday October 4th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 3 p.m. Paper on "Weissenbruch's Signal System on the Belgian State Railways," by Mr. T. S. Lascelles.

Chemical Society.—Thursday, October 5th. At Burlington House, W. At 8 p.m. Ordinary scientific meeting.

Chief Technical Assistants' Association.—Thursday, October 5th. At the Engineers' Club, W. At 6.30 p.m. Discussion on "Electric Vehicles," to be opened by Mr. J. D. Spark.

Brighton Electrical Exhibition.—October 5th to 14th. At the Corn Exchange, Brighton.

Electricity Supply Commercial Association.—Friday, October 6th. At Anderton's Hotel, Fleet Street, E.C. At 7.45 p.m. Third Bohemian concert.

Junior Institution of Engineers.—Friday, October 6th. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Engineering in Bacon Factories," by Mr. W. A. Tookey.

Electrical Power Engineers' Association.—Friday, October 6th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 7 p.m. Lecture on "Boiler Efficiency under Test and Working Conditions," by Mr. D. Wilson, O.B.E.

(Kent Section).—Saturday, October 7th. At the Church Institute, Union Street, Maidstone. At 3 p.m. General meeting at 6 p.m., lecture on "Transformer Breakdowns," by Mr. S. Austin Stigant.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete replies to queries received this week we need the names of manufacturers or suppliers of:—

The Lungen buzzer.
The Joclax flashing sign for windows, used with the Birka lamp.
Deylite lighting fittings.
Simplex electric grill (American—name of British agents wanted).

NOTES.

Silver Solder for Rotor Bars.—Writing to the *Electrical World*, Mr. J. E. Housley, says that it is practically useless to use ordinary solder on rotors, as any severe overload will cause the rotor bars to heat and throw out the ordinary solder. It is comparatively easy to silver-solder rotor bars if the copper section is large enough to prevent melting of the copper under oxy-acetylene flame. The copper must be absolutely clean before soldering. In one case the cleaning was accomplished by suspending the rotor by means of a crane over a small tank of a chemical cleaning compound which was kept boiling by means of a gas heater. The rotor was revolved in this cleaner and all dirt, grease and foreign matter was quickly removed, after which the rotor was silver-soldered.

Appointments Vacant.—Assistant lecturer and demonstrator (temporary) in electrical engineering, for the Northampton Polytechnic Institute; switchboard attendants (£5), for the Edinburgh Corporation electricity supply department. (See our advertisement pages to-day.)

Pre-cast Busbar Ducts.—In the construction of masonry bus structures the building of the horizontal bus compartments has always been the most difficult part of the work. The cost of construction is high, and it is difficult to build a structure which is sufficiently rigid to withstand the short-circuit stresses met in present-day practice.

To overcome these objections the New York & Queens Electric Light & Power Co. has adopted a simple form of bus construction. Rectangular ducts are pre-cast and erected in three horizontal rows, one above the other, the units being staggered so that the openings for bus taps occur at the proper place in each row. The duct walls are 2 in. thick, and for a 2,300/4,000-volt bus the inside dimensions are 12 in. x 13 in. The length is 3 ft. 5¼ in., which is equal to the width of two single-phase compartments. The units are cast in steel forms and reinforced with wire mesh, which is open on one side to prevent possible eddy currents. Each unit weighs approximately 400 lb. Inserts are provided on the top of each unit for the insulator on the bus above. This form of construction provides additional clearance at the supporting insulators where it is needed on account of clamps and bolts.

The cost of this type of construction is considerably less than that of others, and it results in a much more rigid structure.—W. C. Blackwood, in the *Electrical World*.

The Provincial Electric Supply Committee.—The annual meeting of the Committee was held on Tuesday last, under the chairmanship of Sir Harry Renwick, K.B.E. A report will appear in our next issue.

The Electro-Harmonic Society.—The 1922-23 Season of the Society commences on October 11th with a smoking concert. This season the concerts are to be held in the Caxton Hall, Westminster, and the series consists of six concerts, two of which will be open to members' lady friends. Mr. Leo Stormont has been appointed to act jointly with Mr. Bernard Flanders, A.R.A.M., in the musical direction of the concerts.

The Status of Electrical Contractors.

The stinging words, and phrases tense
Of Taunton's censure, deep and strong,
Must surely pierce, however dense,
The brain pans of the E.C. throng.
Wake up! the E.C.A. and strive
To clear your ranks of side-line duds.
In other words: spring-clean your hive
And keep reserved for bluest bloods.

"Nala."

Brighter "Underground" Cars.—The latest improvements in the rolling stock of the District Railway are mainly æsthetic, proving that amidst the rush of modern affairs the ideals of William Morris have not been forgotten. The idea has been to get rid of the "all-steel" atmosphere which pervades the new "all-steel" cars. Mr. Hall Thorpe, the well-known artist, has been called in and has produced a number of novel and pleasing colour schemes. In addition to this the vertical rods which took the place of straps are to be abandoned in favour of the earlier method of accommodating surplus passengers; a kind of foot-rest is to be installed; and the noise-eliminating system devised by Professor A. M. Low is to be incorporated in the new design.

National Association of Supervising Electricians.—The following meetings, to be held at the St. Bride's Institute, Bride Lane, Ludgate Circus, E.C.4, have been arranged, and the chair will be taken on each occasion by Mr. W. E. Highfield, M.I.E.E., President of the Association, at 6.45 p.m.:—October 10th, "Single-phase Commutator Motors; their progress, and reasons why they demand the attention of power engineers," by Mr. F. Creedy, A.M.I.E.E.; November 14th, lecture on "broadcasting," and demonstration by a representative of Marconi's Wireless Telegraph Co., Ltd.; December 12th. "The High Cost of Installations: with special reference to the effect of rings, and bad organisation, on prices," by Messrs. W. J. Revell and F. T. Alldread.

The "Passimeter" System.—The success of the "Passimeter" system of booking passengers, installed a short time ago at the Kilburn Park Station, has led the "Underground" companies to extend it to many other stations, with a consequent speeding-up of traffic through the gates. Another improvement recently introduced is a change-giving machine. It is estimated that 70 per cent. of the passengers do not tender the exact amount of their fares, a circumstance which causes a great deal of delay. With the new machine appears a list of fares from the station at which it is installed, and the apparatus is capable of giving change for all the silver currency (except five-shilling pieces, which are rarely seen nowadays). By this means it is expected to increase the rate of booking from 12 tickets per minute to 20.

A Father's Sacrifice.—The following paragraph, received from our correspondent at the Cape, will remind some of our readers of the days gone by when the employment of councillors' sons in the municipal electric light stations, in the control of which their fathers were interested, formed one of the grounds for the grievances of those who wanted such jobs and could not get them. The case at Oudtshoorn is different from those which arose here years ago, for the son being already apprenticed to the electric light station the district is deprived of his father's services as a councillor: "The candidature of Mr. J. Crosoer for the Oudtshoorn, Cape Province, municipal election was challenged by another candidate on the ground that he was a party to a municipal contract, as his son is apprenticed to the electric light undertaking. Mr. Crosoer has withdrawn."

High-pressure Rectifiers.—Most usually, pressures of 1,500—3,000 V have been chosen for the electrification schemes of main-line railways with direct current. Rotary converters and rectifiers have so far been employed for converting a.c. into d.c. when the contact-wire pressure does not exceed 1,500 V, whereas, for higher pressures, motor-generators have to be used. The latter are not only considerably more expensive, but have a lower efficiency than the former machines. This accounts for the preference accorded to direct current at pressures not greater than 1,500 V in Europe, where only a few lines are operated with higher d.c. pressures, amongst which several railways equipped by Brown, Boveri & Co. may be mentioned, such as the Turin-Lanzo-Ceres Railway (4,000 V), the Rome-Ostia Railway (2,400 V) and the Coire-Arosa Railway (2,000 V). Some months ago, however, Brown, Boveri & Co. designed a new type of rectifier suitable for high d.c. pressures, and this has successfully undergone trials on the test bed. Direct current was supplied continuously at different pressures: first of all, the pressure was 2,500 V and the output 450 A (1,125 kW) per cylinder; the pressure was subsequently raised to 3,500 V with an output of 350 A (1,225 kW), and finally to 5,400 V and 300 A (1,620 kW). During each series of tests, the rectifier remained uninterruptedly on load day and night for a considerable time, without the slightest disturbance occcurring while switching, overload, and short-circuit tests were carried out. The output of the rectifier was dissipated by water resistances. The neutral point of the transformer was earthed, and the rectifier and vacuum pump set were insulated—an arrangement which is usually adopted by the firm for plants of this description. These tests show for the first time that mercury arc rectifiers can not only be built for d.c. pressures of over 5,000 V, but also, that they are technically suitable for such high pressures, as was shown by switching overload and short-circuit tests. Rectifiers are well adapted for completely automatic sub-stations, and several plants of this description equipped by the firm will be placed in service this year. Since d.c. traction motors can now be built for terminal pressures greater than 2,000 V—as has been proved by the motors for the Turin-Lanzo-Ceres Railway—and the construction of switches, controllers, &c., for pressures of 4,000 V and over no longer offers any difficulties, all obstacles which prevented the advantages of electrification of main-line railways with high-pressure direct current from being utilised, have now been removed.—*Brown, Boveri Review.*

A Standard Source of Sound.—In a letter addressed to *Nature* of September 16th, Mr. E. T. Paris, of the Signals Experimental Establishment, Woolwich, suggests the use of a hot-wire grid, as used in the Tucker microphone, for the purpose of constructing a standard source of sound. The grid would be fixed at one end of a Helmholtz resonator, and a telephone at the other end; the telephone would be actuated with current from a thermionic valve oscillator, at a frequency equal to that of the resonator, giving a pure tone of moderate intensity, and the change of resistance suffered by the microphone grid would afford a measure of the amplitude of vibration of the air-column, and therefore of the strength of the source (*sic*), which could be varied at will. If the frequency of vibration were known, the strength of the source could be found in absolute measure.

Educational.—City and Guilds of London Institute.—The Department of Technology informs us that both the Grade I and the Final Examination of the Institute in Electrical Installation Work will be held next year in England and Wales and elsewhere. Those candidates who have not already passed the examination in Grade I should be instructed to take and pass this examination before presenting themselves for the final examination in 1924. All intending candidates are advised to make application to the secretary of the nearest technical school or local education authority with a view to the formation of classes. All candidates will be required to have attended evening classes regularly in the subject of Electrical Installation Work, except in certain special cases, when application should be made before the end of February, 1923, to the Department of Technology, City and Guilds of London Institute, 29, Roland Gardens, S.W.7, for exemption.

Generating Plant in U.S.A. Central Stations.—On October 1st, 1921, there were 5,532 central generating plants in the United States with a total prime-mover rating of 19,737,361 h.p. and a total installed generator rating of 14,466,915 kW. The increase in prime-mover rating during the period from January 1st, 1920, to October 1st, 1921, was 1,170,712 h.p., or at the rate of 3.9 per cent. per annum.

The total rating of the steam motors was reported as 13,331,933 h.p., of which 86.5 per cent. was attributed to steam turbines. During the twenty-one-month period from January 1st, 1920, to October 1st, 1921, the total rating of the installed steam turbines was increased by 1,487,367 h.p., while the total rating of the installed steam engines was increased by only 31,733 h.p.

The total rating of the installed water-wheels was 6,200,245 h.p. The rating of waterwheels installed in central generating plants increased by 822,845 h.p. subsequent to January 1st, 1920, an increase of about 15.3 per cent. Internal-combustion engines were rated at 205,183 h.p.—*Electrical World.*

Explosives in Mines Committee.—The Secretary for Mines has appointed the following committee to carry out under the general direction of the Safety in Mines Research Board research into the causes of, and the means of preventing, the ignition of firedamp and coal dust by the firing of permitted explosives:—Col. Sir F. L. Nathan, K.B.E. (chairman); Mr. W. Rintoul, O.B.E., F.I.C.; Dr. G. Rotter, O.B.E.; Mr. H. Walker, C.B.E.; and Prof. R. V. Wheeler, D.Sc. A grant has been made by the Miners' Welfare Committee out of the Miners' Welfare Fund to meet the cost of initiating the research.

The Song of the Electric Way.

(With apologies where necessary.)

When sonorous call electric,
Announces early morning,
In baths approaching hectic,
We splash before adorning.
No thought of gas or matches,
Or taps and gadgets numerous,
One trace of pleasure snatches,
Byegone ideas are humorous.
To tune the time by wireless,
As breakfast elements glimmer,
The ether pulses tireless,
While eggs and bacon simmer.
In summer fans play gently
At button's press projected,
And winter finds us potently
By radiant heat protected.
By trolley and bow contacted,
Flow energies harmonious,
Time space is counteracted,
To reach our city terminus.
Amenities electrical,
Reduce the day's distraction,
And typists cease to pall
In dictaphone's reaction.
At home the dishes glisten,
Thro'-whirr of motor wash
And launderers by us hasten,
To homes not quite so "posh."
Since telegram and 'phone,
And 'type and radiograms,
Reduce the hours from home,
And foster epigrams,
By omnipotence electric,
'Fore dusk all work's long past,
Th' electric way redeems the day,
And music is broadcast.

F. A. P.

The Electrical Trades Benevolent Institution.—Annual Festival.—The Festival will be held at the Trocadero Restaurant on November 15th; Sir James Kemnal will preside, and ladies will be present.

Train Heating by Electrically-heated Boiler.—Since the electrification of the Swiss Federal Railways was partially carried through, the heating of the carriages has been effected by electric radiators, except in international trains, in which steam heating, as previously used, has been adhered to temporarily. As a result of this some source of steam has to be provided on the train itself, and this has been done by installing an electrically-heated boiler specially adapted to the requirements of the railways. For purposes of economy it was decided to use the current of the overhead line, the voltage of which is 1,500 V, without transforming it, but this gave rise to insulation difficulties. Further, it was found desirable to install the boiler on a special coach, capable of being coupled to any desired point on the train, in order to obtain uniform heating. The following is a brief description of the installation as finally designed by Messrs. Brown, Boveri & Sulzer Bros. (*Schweiz. Bauzeitung*):—

Placed in a van, the boiler absorbs 800 kilowatts, and supplies steam at a pressure of 8 kg. (about 113 lb./sq. in.). The current from the overhead line is received by a pantograph provided with the usual fittings (pneumatic gear) and safety devices. The high-pressure fittings are, moreover, enclosed and inaccessible when the pantograph is raised. The boiler is fed by two injectors and fitted with a circulating pump operated by a low-pressure motor (fed from a small transformer connected to the 15,000-volt lead). The object of this pump is to equalise the steam production by constantly renewing the water round about the electrodes, so as to avoid sudden gushes of steam. There are two electrodes, which can be operated singly or together, while their effect can be regulated by sliding the insulating tubes that embrace them. Traps are provided for evacuating the steam from the roof of the coach in case of accident, and the opening of these traps automatically lowers the pantograph from the overhead line. The compressed air for these operations is taken from the main pipe of the Westinghouse automatic brake, or, if the coach is not connected up with that supply, the air is supplied by a small hand-operated pump.

It is interesting to note that the new electric locomotive described elsewhere in this issue is fitted with an electrically-heated boiler, constructed by the Bastian Electric Co., Ltd.

INSTITUTION NOTES.

Institution of Production Engineers. — Mr. Max R. Lawrence, works manager of The Sterling Telephone and Electric Co., Ltd., Dagenham, Essex, has been re-elected President of this Institution for the 1922-1923 session. Mr. W. L. Fisher, of Richmond, Surrey, and Mr. H. E. Honer, of Dartford, Kent, have been elected Vice-Presidents. For the coming session the following papers have been arranged:—

October.—Presidential address.
November.—"Standardisation," Mr. G. Hey.
December.—"The Production Engineer," Mr. H. E. Honer.
January.—"The Principles of Organisation and Management," Mr. Wallace Attwood.
February.—"Machine Moulding Methods," Mr. F. T. Hardyman, foundry manager, Messrs. Petters, Ltd., Yeovil.
March.—"Modern Gauging Systems," Mr. Axel Wickman, of Messrs. Alfred Herbert, Ltd.
April.—"Tooling for Production," Mr. L. C. Keen, consulting production engineer.

Local branches of the Institution have already been formed at Coventry and Newark-on-Trent, and it is hoped to inaugurate a local section at Glasgow during the coming session.

Rotherham Technical Engineering Society.—Mr. E. Cross, the Corporation electrical engineer, in his presidential address, enlarged upon the part which electricity was destined to play in future progress. He showed how much more efficient electric traction was than steam locomotion, and predicted that the all-electric house would be a popular institution in Rotherham before very long. Mr. Cross thanked the hon. secretary, Mr. Stansfield, for his services to the Society.

Glasgow and District Radio Club.—The Club resumed its activities with the annual general meeting, which was to be held at the new premises in Buchanan Street on September 27th. At this meeting the election of office bearers, &c., was to be carried out.

The Club has arranged for a public exhibition and demonstration of wireless reception at the McLellan Galleries Hall, Sauchiehall Street, on November 4th. The committee asks firms who wish to be represented to send full particulars of offers to the Hon. Secretary as soon as possible. Prof. G. W. O. Howe, D.Sc., M.I.E.E., has kindly consented to deliver an address, and special messages from Continental stations have been arranged.

A syllabus for the ensuing session is in the course of preparation, and the secretary asks for contributions to the winter's programme.

Bradford Engineering Society.—The winter syllabus of the Society, the president of which is Mr. C. E. Allsop, of the Bradford Corporation electricity department, includes a series of lectures on all phases of engineering. On the electrical side the president is to open on October 2nd with a lecture on "The Development of Public Electricity Supply." The Society has secured the services of a number of leading experts who will deal with various methods of securing the maximum of economy in power production. The meetings are held at the Technical College, where the hon. secretary, Mr. G. F. Charnock, is Professor of Engineering.

Institution of Railway Signal Engineers.—The programme for the remainder of the 1922-23 session is as follows:—October 4th, "Weissenbruch's Signal System on the Belgian State Railways," by T. S. Lascelles; November 1st, "A Few Remarks on Railway Accidents," by J. Holt; December 6th, "Intermediate Block Signalling," by C. Carslake; January 3rd, 1923, "Rotary Interlocking Block," by A. Wallis; and February 14th, annual general meeting.

Faraday Society.—The Faraday Society and the British Cold Storage and Ice Association will hold a joint meeting on October 16th. The meeting will be held at the Institution of Electrical Engineers, and it will be divided into three sessions. At the first session, following a general introduction by Prof. Alfred W. Porter, F.R.S., the subject to be discussed will be "Laboratory Methods of Liquefaction and Methods of Measuring Low Temperatures." The opening address will be delivered by Prof. H. Kamerlingh Onnes, and Dr. Crommelin will give a description of the equipment of the Cryogenic Laboratory at Leyden. Subsequent contributors will include Prof. C. F. Jenkin and Dr. Ezer Griffiths. The second and third sessions will be devoted to "Industrial Methods of Liquefaction and Practical Applications of Low Temperatures." The general introduction to this subject will be given by Mr. K. S. Murray, of the British Oxygen Co., Ltd., and among those who will contribute papers will be Monsieur Claude, on "The Industrial Manufacture of Hydrogen by the Partial Liquefaction of Water Gas," and Mr. E. A. Griffiths, who will deal with the subject as it touches aeronautical work. Messrs. Liquid Air, Ltd., will arrange some demonstrations during the intervals, and will also contribute information on the Heylandt system of air liquefaction and on the use of liquid oxygen in blasting. Those desirous of attending are invited to communicate with the Secretary of the Society, 10, Essex Street, W.C. 2.

Institute of Physics.—The third of the series of lectures being delivered under the auspices of the Institute of Physics on "Physics and the Physicist in Industry" will be given by Mr. Clifford C. Paterson on Wednesday, October 18th, at 6 p.m., at the Institution of Electrical Engineers, Victoria Embankment, W.C.2. Mr. Paterson will deal with the "Physicist in Electrical Engineering." Sir J. J. Thomson, O.M., president of the Institute, will take the chair.

OUR PERSONAL COLUMN

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

The *Commonwealth Engineer* reports that Mr. A. W. Kendall has resigned from the position of managing director of the Australian General Electric Co., Ltd., and at the request of the International General Electric Co. is remaining on the board of directors. Mr. Kendall, who is taking up other important interests, has been with the company for 19 years, and for the last 12 years filled the position of managing director, during which period the company's business has increased eightfold. Mr. Kendall was to relinquish control at the end of August.

Mr. F. Charles Raphael, M.I.E.E., has resigned the position of manager of the Cable and Wire Department of the Edison Swan Electric Co., Ltd. For the present, communications should be sent to his home address, 35, Chase Green Avenue, Enfield, Middlesex (telephone, Enfield 664) where he is carrying on his consulting work. He desires to receive catalogues from manufacturers of fittings and accessories for house wiring, &c.

The Faraday medal of the Institution of Electrical Engineers, the first award of which was made by the Council in the early part of the year to Mr. Oliver Heaviside, F.R.S., was personally presented to him by Mr. J. S. Highfield, President of the Institution, at Torquay, on September 9th.

Councillor John E. Gibbs, who was formerly with Messrs. Ferranti, Ltd., is Sheriff-elect of York. He is now head of the firm of Gibbs & Co., of York, and is vice-chairman of the Corporation Tramways and Electricity Committee.

The Edinburgh Corporation has appointed Mr. J. Hagen, of Glasgow, to be boiler-house superintendent at the new power station at Portobello, at £400 per annum. Mr. Hagen is at present at Dalmarnock electricity station. Mr. W. Duncan, at present manager of the electrical department of the Victoria Brass Foundry Co., Leith, has been appointed sales superintendent for the Edinburgh Electricity Department, at £500 per annum.

Last week, at Dundee, Major H. Richardson, J.P., was presented with a dressing-case with silver and ivory fittings, as a mark of esteem from the chief officials of the Corporation on the occasion of his vacating his present position in the City. Mr. W. H. Blyth Martin, Town Clerk, supported by Lord Provost Spence, in handing over the gift, made reference to the many valuable services rendered to the city by Major Richardson, who replied in his characteristically happy manner.

Mr. Arthur Foden has resigned his position with the Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, to take up the position of engineer-in-charge with the Eccles Corporation electricity department.

Mr. A. R. Henderson, A.M.I.E.E. (late Lieut. R.N.V.R.), is terminating his engagement with the Admiralty as an engineer-in-charge of design in order to return to commercial engineering. He wishes to hear from pre-war business friends, and to receive manufacturers' catalogues at 53, Lawrence Road, Southsea.

Obituary.—Mr. J. T. Fahy.—We regret to learn from the *Commonwealth Engineer* that Mr. J. T. Fahy, who recently retired from the position of chief electrician, New Zealand railways, after 42 years' service, died in July in Sydney at the age of 57 years. "The late Mr. Fahy was for many years in the Dominion's telegraph department. With Mr. T. Buckley (later controller of telephone services), he took part in experimental wireless telegraphy in its early stages. It is believed that these two officers were, in 1898, the first south of the equator to establish perfect ink-marked Morse signals on tape over short distances. They also designed a forked quadruplex, which, when perfected, Mr. Fahy installed at Blenheim, where it has been worked for over 20 years. In 1901, Mr. Fahy was transferred to the railway service as electrician, where he did valuable work in the erection of railway telegraph and telephone lines. Mr. Fahy was an associate member of the Institution of Electrical Engineers and an associate of the American Institute of Electrical Engineers."

Dr. Reiss.—*The Times* Paris correspondent reports that Dr. Reiss, of Metz, has died at the age of 64 from the effects of using X-rays in the treatment of patients at the Sainte Blandine Hospital.

Alderman T. P. Bird.—We regret to announce the death of Mr. Alderman T. P. Bird, J.P., the deputy-chairman of the Birmingham Electric Supply Committee, who had been a member of the committee since 1911. Alderman Bird was also an active member of the District Industrial Council for the West Midlands area, and its municipal representative on the National Council for the industry. He was also chairman of the District Joint Board and the district's representative on the National Joint Board. He devoted a considerable amount of his time to matters connected with the electric supply industry.

There was a very large attendance at the funeral, at Aston Church, on Saturday, including the Lord Mayor of Birmingham and the chairman (Mr. H. K. Beale), and members of the Birmingham Electric Supply Committee.

Mr. S. H. Fielden.—We learn with regret of the death of Mr. S. H. Fielden, who was for many years connected with Rhodes Motors, Ltd., and was for part of the time a director of that company. He subsequently went to Australia to take up an appointment with Messrs. H. V. Mackay at Sunshine, Melbourne. During the war he joined the Australian forces and saw fighting in Egypt and France. He was badly gassed and suffered from shell shock, and was appointed instructor at the camp at Christchurch. On demobilisation he rejoined Messrs. Rhodes Motors, Ltd., as their export manager in London. He had to give up work in 1921 owing to the state of his health, and he passed away on September 16th at a nursing home.

Will.—The late Mr. C. H. Shuter, of Westminster, submarine telegraph and cable engineer, left £15,279.

NEW COMPANIES REGISTERED.

Broadcast Wireless Co., Ltd. (184,466).—Private company. Registered September 20th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in apparatus and component parts in connection with wireless telegraphy and telephony, &c. The first directors are: C. D. Rutter, Holly Lodge, Chestnut Grove, New Maldon, Surrey; A. S. Young, 7, Upper Hornsey Rise, N.19; G. O. Tutton, St. Olaves Lodge, 47, Wimbledon Park Road, Southfields, S.W.18. Qualification: 50 shares. Remuneration as fixed by the company. Secretary: A. S. Young. Registered office: 2, Tower Royal, Cannon Street, E.C.4.

Ajax Production Engineers, Ltd. (184,368).—Private company. Registered September 14th. Capital, £3,000 in £1 shares (1,500 ordinary and 1,500 7 per cent. cumulative preference). To adopt an agreement with Ajax Manufacturing Co. and to carry on the business of electrical, mechanical, motor and sanitary engineers, founders, smiths, machinists, ship and boat builders, manufacturers of agricultural implements and motor cars, &c. The subscribers (each with one share) are: W. C. Terry, 123, Upper Clapton Road, E.5, manufacturer; W. T. Frost, 4, Seymour Road, Church End, Finchley, N.3, manufacturer. The first directors are to be appointed by the subscribers. Qualification: £50. Remeuneration: 10s. 6d. each per meeting attended. Secretary: H. J. Bellingham. Registered office: 188-189, Strand, W.C.

Barlow & Redruth, Ltd. (184,464).—Private company. Registered September 20th. Capital, £500 in £1 shares. To acquire the business of electrical and general engineers' merchants and hardware merchants and manufacturers carried on by L. R. Incledon, S. V. Reynolds, and A. G. Stanners as "Barlow and Redruth," at Wolverhampton, Staffs. The first directors are: L. R. Incledon (permanent); "Winnats," Penn, near Wolverhampton; S. V. Reynolds, 218, Birmingham Road, Walsall; E. C. Stanners, Parkhurst, Westbourne Road, Penn, near Wolverhampton. Registered office: 2, St. John's Street, Wolverhampton.

Nicholson and Lord (Walsall), Ltd. (184,489).—Private company. Registered September 21st. Capital, £2,000 in £1 shares. To take over from A. Sherratt and R. F. Sherratt the business of organ builders and tuners, together with the tuning contracts lately acquired by them from the liquidators of Nicholson and Lord, Ltd. The permanent directors are: A. Sherratt, 2, Cambridge Crescent, Erdington, Birmingham, electrical engineer; R. F. Sherratt, 2, Cambridge Crescent. Erdington, Birmingham, electrical engineer; T. Sherratt, 3, Crooked Usage, Church End, Finchley, N.W., telephone engineer. The two first named are managers. Qualification: 50 shares. Registered office: 20, Vicarage Place, Walsall.

Cooke and Whitfield Wireless, Ltd. (184,509).—Private company. Registered September 22nd. Capital, £5,000 in £1 shares. To carry on the business of manufacturers of, and dealers in, wireless telegraphy and telephony apparatus and components, and erectors and maintainers of receiving, transmitting, and broadcasting stations, &c. The life directors are: H. S. Cooke, Broadway, St. Bernard's Road, Olton, Warwick; H. H. Whitfield, The Glen, Primrose Lane, Hall Green, Birmingham, electrical engineer. Qualification, £100. Remuneration as fixed by the company. Registered office: 24, St. Paul's Square, Birmingham.

Bann Syndicate.—Registered on September 22nd as a private company with a nominal capital of £10,000 in £1 shares. The objects are:—To promote or assist in promoting a bill or bills in the Parliament of Northern Ireland or any other seat of parliament (1) granting permission and making provisions for the supply of electrical energy, (2) sanctioning the erection, purchase and maintenance of works, generating and electrical power supply stations for the production and supply of electricity, (3) giving directions and granting permission to construct, acquire, install, and maintain machinery, &c., connected with generation, distribution, supply, accumulation and employment of electricity, (4) giving permission and directions to sink wells and shafts, and to buy, build, maintain, or pull down reservoirs, waterworks, aqueducts, electric and hydraulic engines, and other works and appliances which may seem conducive to the production and supply of electricity, and (5) giving authority and directions to promote and assist in promoting and/or operating railways, tramways, hydraulic works, electric and other lighting works, or any of them, and the business of supply connected therewith, &c. The subscribers (each with one share) are: R. C. Howley, 17, Throgmorton Avenue, E.C., clerk; W. H. Morgan, Broxash, Marguerite Drive, Leigh-on-Sea, clerk. The subscribers are to appoint the first directors. Remuneration as fixed by the company. Solicitors: Ashurst, Morris, Crisp and Co., 17, Throgmorton Avenue, E.C. No notice of situation of registered office was filed at the time of registration. The file number is 184,506.

Hayner Engineering Co., Ltd. (184,485).—Private company. Registered September 21st. Capital, £200 in £1 shares. To carry on the business of manufacturers of and dealers in all kinds of electrical and mechanical apparatus, &c. The first directors are: H. T. Warner, 8, King's Road, N.W., electrical engineer; H. F. Hayward, 42, Church Road, N.W.10, electrical engineer. Qualification: 20 shares. Registered office: 68, Harlesden Road, Willesden Green, N.W.10.

Clarence R. Foster, Ltd. (184,522).—Private company. Registered September 22nd. Capital, £10,000 in £1 shares (3,000 6 per cent. cumulative preference and 7,000 ordinary). To take over the business of an electrical and motor engineer carried on by C. R. Foster at 170, Cardigan Road, Leeds. The first directors are: C. R. Foster, Glenholme, Victoria Gardens, Horsforth, Leeds; G. F. Storey, 15, Ashleigh Road, West Park, Leeds (director of Storey Evans & Co., Ltd.). C. R. Foster may retain office while holding 3,500 of the shares to be allotted to him under purchase agreement. Qualification of other directors £100. Registered office: 170, Cardigan Road, Leeds.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Marston Billington, Ltd.—Particulars filed of £14,000 debentures authorised June 16th, 1922, charged on the company's undertaking and property, present and future, including uncalled capital; the whole amount being now issued.

Luminor Signs (British), Ltd.—Particulars filed of £500 debentures authorised June 22nd, 1922, charged on the company's property, present and future, including uncalled capital; the whole amount being now issued.

V. P. Webb & Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital dated September 7th, 1922, to secure £3,800. Holder: Mrs. A. B. B. Webb, Clent House, Clent, Worcestershire.

Mikro, Ltd.—Particulars filed of £500 debentures authorised June 23rd, 1922, charged on the company's undertaking and property, present and future, including uncalled capital; the amount of the present issue being £450.

CITY NOTES.

French Cable Company. The report of the Compagnie Francaise des Cables Télégraphiques states that the decrease of 3,000,000 fr. in the receipts in 1921 as compared with the preceding year was due to the contraction in general business and the increased use of codes in cable messages. The diminution has continued in 1922, but on the other hand, cable charges have been increased and also further raised since May 16th, 1922. Good results were obtained from the company's participation in the Société de Télégraphie sans Fil and in the Société Radio France. Works in connection with the modernisation of working were carried out during the year, particularly with regard to relay stations. The net profits amount to 10,097,000 fr., and a dividend has been declared at the rate of 37.69 fr. gross per ordinary share.

Halifax and Bermudas Cable Co., Ltd.—The net result of the year ended June, 1922, is a credit balance of £6,878, as compared with £18,465 for the previous year; the balance brought forward from last year was £61,557, making a total of £68,434. £1,992 has been expended on repairs. A total dividend of 6 per cent., free of tax, for the year absorbs £3,000, leaving to be carried forward £63,442, subject to corporation profits tax. The decrease of £11,588 in the net result of the year's working is accounted for by a reduction of £8,558 in the receipts, principally due to the reduction of rates and wireless competition at Bermuda, an increase of £2,776 in income tax, E.P.D., and corporation profits tax, and an increase of £253 in the general expenses. Mr. G. Clapperton has been elected to the board in place of the late Mr. G. G. Ward.

Radio Corporation of America.—According to a daily paper the operations of the company for 1921 resulted in a profit of $426,799, which has been applied to "Reserve for Patents." No dividends were earned on either the preferred or the common stock, and the amount set aside for patents is stated to be quite inadequate for writing-down purposes. The year's record of business done, however, is very satisfactory; gross revenue from trans-oceanic communications increased 137 per cent. over the previous twelve months, and sales increased by 184 per cent.

Dundee, Broughty Ferry and District Tramways Co.—Profit for year ended July 31st (including £474 brought in), £5,517. Interest on debenture stock and interim dividend paid on preference shares for half-year, less tax, absorbed £2,234. Dividend on ordinary shares at 7 per cent. per annum, less tax; reserve £500; carried forward £241.

Lancashire Electric Light and Power Co., Ltd.—A dividend of 3¼ per cent. for the half-year ending September 30th on the cumulative participating preference shares is announced.

German Company.—The Electricity Supply Co., of Hamburg, reports net profits of 252,000 marks and a dividend at the rate of 15 per cent. for 1921-22, these figures comparing with 116,000 marks and 10 per cent. in the previous year.

Cuba Submarine Telegraph Co., Ltd.—Interim dividend for the half-year ended June at the rate of 5 per cent. per annum, free of tax, on the ordinary shares.

Direct West India Cable Co., Ltd.—Net result of working during year ended June, 1922, a credit balance of £15,965, as compared with £14,601. Balance forward £96,051, making a total of £112,015; £24 expended on repairs; dividend, 6 per cent. free of tax; carrying forward £108,391, subject to corporation profits tax. The company's cables have worked efficiently during the year. The insulation of the Bermuda-Turks Island section remains very low. Mr. G. Clapperton has been elected to the board in place of the late Mr. G. G. Ward.

Stock Exchange Notice.—The undermentioned has been ordered to be officially quoted :—

Jutland Telephone Co.—£500,000 5½ per cent. sterling bonds of 1922 (bearer) (Nos. A1 to A3,500—£100 and B1 to B300—£500) (guaranteed by Danish Government), in lieu of scrip now quoted.

Midland Electric Corporation for Power Distribution.—Interim dividend on the ordinary shares at the rate of 8 per cent. per annum for the six months ended June 30th last.

Shanghai Electric Construction Co.—First interim dividend at rate of 6 per cent. actual (12s. per share), less tax, in respect of year 1922.

STOCKS AND SHARES.

Tuesday Evening.

With the removal of the war-cloud which hung over the Near East, a greater measure of assurance returned to the Stock Exchange markets, bringing with it a revival of business in certain directions. Keen interest centres at the moment around the daily-expected terms of the grouping arrangements in connection with the Southern railway companies. Already, the Isle of Wight Central proprietors have received notices of the offers which are to be made to them, and speculation fastens upon what may happen in the case of the popular trio, South-Eastern & Chatham, Brighton, and South-Western companies in the same connection. It is considered likely in the market that all three companies, which are known to have extensive electrification programmes, are probably waiting for the grouping arrangements to be crystallised before they, the companies, take steps in the direction of starting upon the important work that lies in front of them in connection with electrification.

Electrical railway stocks are inclined to be better, with Metropolitans a good spot at 57. Underground £10 shares touched 3¼, and at 3 show a net rise of 5s. Central Londons are marking time, and Districts remain firm at 42.

The agitation which has arisen in some of the Metropolitan boroughs for reduction of the price of electric current to consumers, in those districts, is being watched closely by proprietors of shares in the electricity companies. The recent newspaper campaign against gas charges has had its effect upon certain stocks and shares in the gas market. The electricity companies are not, of course, in the same position, and, having regard to the profitable nature of the present year's working, there is not likely to be any particular effect felt upon shares in this section even if the companies should make any alteration in the manner of their charges. As is generally known, big schemes are afoot for extension of supply of energy, and this factor operates in the direction of continually contributing to reduction of costs, while it increases the business handled by the companies.

Metropolitan ordinary shares at 6 are ½ down, South Londons at 4 are unchanged, but are ex the dividend of 2s. recently deducted. County ordinary and preference are both 6d. lower, and the new shares at 3s. and 1s. 10½d. premium, for ordinary and preference respectively, are both a trifle under the best.

The market for cable stocks and shares shows a hesitating tendency. Indo-European have fallen £1 to 34½. Great Northerns are 15s. down at 28¾. Eastern Extensions at 18⅝ shed 2s. 6d. and Anglo-American preferred shows a loss of 1½ at 102½. The Marconi market is quiet, prices remaining fairly steady, although Radio Corporations continue heavy, the ordinary falling to 20s.; the preferred are 13s. 9d. Canadian Marconis incline to sag, the present price being 10s. 3d. Holders of Marconi shares are disappointed at the delay which has occurred in carrying-out the broadcasting programme boldly outlined by the Postmaster-General a couple of months ago, a programme which raised natural expectations that the present wireless concerns would stand to benefit substantially by what was expected to be the immediate extension of the new service. What stands in the way of prompt developments it is difficult to understand; in the meantime, the shares of the various companies likely to be affected by the additional business, are attracting little attention.

In this connection, it may be as well to sound a note of warning with regard to schemes that are being put forward in certain directions, through which investors are invited to apply for shares in broadcasting companies that are to make, according to the glowing prophecies of the circulators, a fortune for the present investors. Some, at any rate, of these companies have little more to recommend them than the rose-ate estimates set out on cheap paper. Possibly these will appeal to the unwary, who may be warned by readers of this paper that if they want to get rid of their money, the hospitals are likely to make better use of it than share touts with certificates to sell.

Brazilian Tractions have again receded to 49, making a fall of 4 points within a fortnight, and the market in most Brazilian issues remains depressed, owing to the unhappy plight of the milreis. The Mexican group has not moved. British Columbia Electric Railway deferred is 1 down. On the other hand, Anglo-Argentine Tramways 5 per cent. debenture stock recovered 2 points to 80½, upon attention being directed to the fact of its undue weakness, having regard to the nature of the security offered.

Amongst manufacturing shares, Siemens ordinary show a fall of 1s. 9d. at 25s. 9d. For this, the market assigns no particular reason. Probably if the decline continues, we shall hear doubts as to whether the company can maintain the 10 per cent. tax-free dividend which it has paid hitherto. The 4½ per cent. debentures keep steady at 90, and the 10 per cent. preference shares at 31s. 3d. General Electric preference gave way to 21s. 3d. English Electrics at 15s. 6d., and Edison-Swans at 3s. are both a little easier. British Insulated retain their substantial rise at 45.

Babcock & Wilcox are dullish at 58s. 9d., in consequence of the depression produced in the iron and steel market by the closing-down of the giant Ebbw Vale works in South Wales. This, however, has not affected the armament list, where Vickers and Armstrongs hold their prices. Rubber shares continue to show a little animation, the slight rise in price of the raw product affording ground for the perennial hope that the time is at hand when steady upward progress may be expected.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1920.	Dividend 1921.	Price Sept. 26, 1922.	Rise or fall.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	12	12	8	—	£7 10 0
Charing Cross Ordinary	8	9	7⅞	—	5 17 0
do. do. do. 4% Pref.	4½	4½	4	—	5 12 6
Chelsea	6	6	6¼	—	4 16 0
City of London	14	14	29/-	—	6 11 9
do. do. 6 per cent. Pref.	6	6	25/-	—	5 4 4
County of London	8	8	18	—6d.	5 16 4
do. do. 6 per cent. Pref.	6	6	1⅝	—6d.	5 4 4
Kensington Ordinary	9	10	7½	—	6 13 4
London Electric	2½	4	28	+ ½	4 11 5
do. do. 6 per cent. Pref.	6	6	5	—	5 17 1
Metropolitan	7	7	6	— ⅛	5 16 8
do. 4½ per cent. Pref.	4½	4½	4	—	5 12 6
St. James' and Pall Mall	12	12	9	—	6 13 4
South London	7	7	4xd	+ ⅛	7 0 0
South Metropolitan Pref.	7	7	1⅜	—	5 18 0
Westminster Ordinary	10	10	7⅜	—	6 11 2
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref	6	6	102½	—1½	5 17 1
do. Def.	1½	84/6	23½	—	7 8 6
Chile Telephone	6	6	6	—	5 0 0
Cuba Sub. Ord.	7	7	8½	—	8 9 8
Eastern Extension	10	10	18⅝	— ¼	5 7 5
Eastern Tel. Ord.	10	10	18⅝	—	5 7 8
Globe Tel. and T. Ord.	10	10	18⅜xd	— ¼	5 6 8
do. do. Pref.	6	6	11½xd	—	5 4 4
Great Northern Tel.	24	22	28¾	— ¾	7 18 0
Indo-European	10	10	34½	—1	7 5 0
Marconi	25	15	2⅝	—	6 6 4
Oriental Telephone Ord.	12	12	24	—	*5 1 1
United R. Plate Tel.	8	8	6¾	—	*5 18 6
West India and Panama	Nil	Nil	6/-	—	Nil
Western Telegraph	10	10	18½xd	— ¼	*5 8 1
Home Rails.					
Central London Ord. Assented	4	4	87	—	5 19 5
Metropolitan	1½	2½	57	+1	3 19 0
do District	Nil	1	42	—	2 6 6
Underground Electric Ordinary	Nil	Nil	3	+ ¼	Nil
do. do. "A"	Nil	Nil	8/-	+6d.	Nil
do. do. Income	2	4	80½xd	+1	*4 12 6
Foreign Trams, &c.					
Anglo-Arg. Trams, First Pref.	6½	12½	87	—	8 0 0
do. do. 2nd Pref.	Nil	5⅝	84½	—	7 0 9
do. do. 5 per cent. Deb.	5	5	80½	+2	6 4 3
Brazil Tractions	Nil	Nil	49	—1	8 0 0
British Columbia Elec. Rly. Pcc.	5	5	70½	—	6 9 9
do. do. Preferred	5	99/-	66	—	*7 1 8
do. do. Deferred	8	124/-	71½	—1	*8 12 6
do. do. Deb.	4½	4½	75xd	—	5 13 4
Mexico Trams. 5 per cent. Bonds	Nil	Nil	70½	—	7 1 10
do. do. 6 per cent. Bonds	Nil	Nil	41½	—	Nil
Mexican Light Common	Nil	Nil	20⅝	—	Nil
do. Pref.	Nil	Nil	48½	—	Nil
do. 1st Bonds	Nil	5	64½	—	7 14 6
Manufacturing Companies					
Babcock & Wilcox	15	15	2½	—	5 12 3
British Aluminium Ord.	10	5	17 9xd	—	5 12 8
British Insulated Ord.	15	15	32	—	6 13 4
Callenders	15	15	2⅛	—	6 17 0
do. do. Pref.	6⅔	6⅔	1⅛	—	5 15 7
Crompton Ord.	10	5	15/-	—	6 13 4
Edison-Swan	10	Nil	3/-	—3d.	Nil
do. do. 5 per cent. Deb.	5	5	64	—	7 16 4
Electric Construction	10	10	1⅛	—	8 0 0
English Electric	8	5	15/6	—6d.	6 7 0
do. do. Pref.	6	6	1	—	6 0 0
Gen. Elec. Pref.	6⅔	6⅔	21/3	—9d.	6 2 4
do. Ord.	10	5	19/-	—	6 5 3
Henley	15	15	2⅛	—	6 9 10
do. 4½ Pref.	4½	4½	4⅜	—	5 2 10
India-Rubber	10	—	⅛	—	—
Met.-Vickers Pref.	8	8	2⅛	—	6 8 0
Siemens Ord.	10	10	25/9	—1/9	*7 15 4
Telegraph Con.	30	30	36½	—	*4 13 6

* Dividends paid free of Income Tax.

DYNAMOS AND MOTORS OF COMPARATIVELY SMALL OUTPUTS.

By J. W. BURLEIGH, A.M.I.E.E.

(*Concluded from page* 407.)

The writer does not wish to imply that it is a relatively easy matter to compare costs and facility of production for different constructions and to put it in terms of pounds, shillings, and pence. It often requires a simultaneous consideration of many factors to arrive at a true comparison, and only the experienced engineer can hope to do this readily.

A reference to figs. 4 and 5 will clearly show the new construction. The magnet system is characterised by each pole being divided into two parts or limbs, which are so disposed that the angle between their axes is large, permitting of very effective ventilating apertures

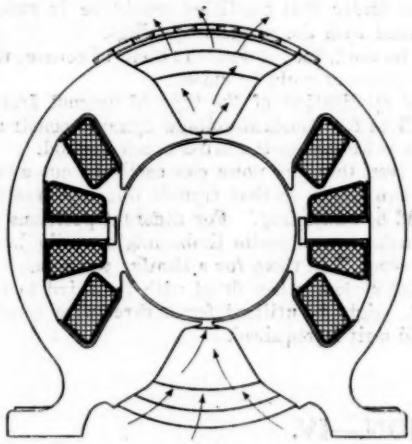

Fig. 4.

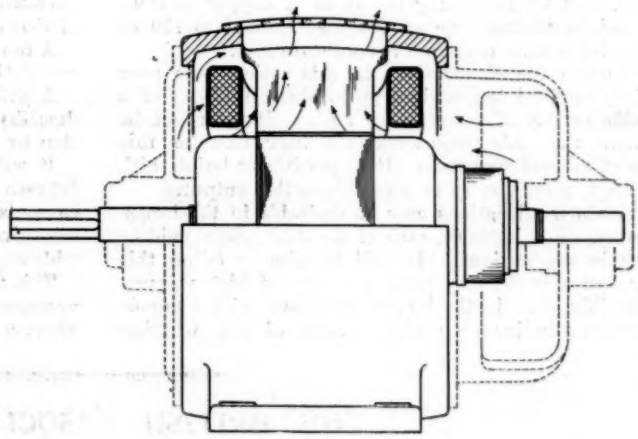

Fig. 5.

at the top and bottom of the frame. Further, it will be seen in fig. 4 that, although pole tips are cast with the poles, the design is such that the field coils lie close to the limbs when passing through the space between the poles.

Each pole is excited by a single coil, slightly arched. Fig. 6 is a development of the pole, showing preferred form of field coil.

It may be interesting to note that patent No. 5,602, dated March 8th, 1906, granted to the writer, describes a somewhat similar magnet construction. The excitation of each pole of this magnet system is effected by two coils, one coil being mounted on each part or limb.

Divided poles are, of course, well known. It is doubtful if a single dynamo designer, past or present, has not, at some period, constructed machines having a division in the main poles transverse to the armature laminations. Many interesting patent specifications have been based on this principle.

The large ventilating space between the two parts of each pole is of very real importance. It forms, in effect, an excellent ventilating shaft—all the heat-generating members being practically within the cooling air circuit, which extends vertically through the machine. Very effective natural ventilation is thus provided without having recourse to forced ventilation by means of a fan.

The field coils are preferably spread at the sides of the magnets, as shown in figs. 5 and 6. By so disposing the coils, free passages are provided between the poles and coils which allow the cooling air to more readily flow through the machine. Secondly, it admits of the coil having an elliptical (and therefore easily wound) shape.

One might think at first sight that the field coils are not removable owing to the pole tips. This idea will be dispelled by a consideration of fig. 7, which shows that the field coils can be placed on or withdrawn directly and with a straight-line motion.

A magnet system designed on the lines indicated has preferably the yoke, poles, and pole tips cast in one member. It has the great advantage that the main field magnet material may be of cast iron only.

The magnets are comparatively light in weight (approximately equal to half the total weight of the machine) by reason of the advantages arising from the particular disposition of the materials.

It is interesting to note that with an average density of 6,500 lines per sq. cm. in the magnets (neglecting the leakage flux) the ampere turns required for the total iron paths are only about 160 for a three-quarters brake horse-power motor at 1,600 r.p.m., and about 220 ampere turns for a two brake horse-power motor at 1,500 r.p.m. These figures show great economy, and result in a low weight of copper being required for the field coils.

For the three-quarters brake horse-power motor referred to, the total weight of wire, including the covering, is not over 2 lb. per pole. The two brake horse-power motor at 1,500 r.p.m. only requires about 5 lb. of wire per pole.

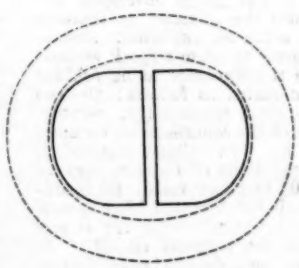

Fig. 6.

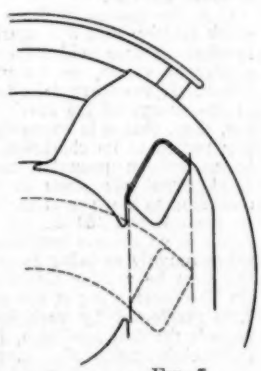

Fig. 7.

Machines constructed with the cast-iron magnet system described are found to be nearly as light as with a two-pole construction having cast-steel yoke and poles and fitted with a fan.

They are certainly as light as a four-pole construction having a cast-iron yoke and steel poles, even when refinements are embodied.

In comparing the weights of dynamo machines, both large and small, it is interesting to find that the law, or formula, laid down by Fischer-Hinnen a great many years ago applies at the present time. In his book, "Continuous-Current Dynamos," dated 1899, he states that the weight in lb. = $Wr^3 \times C$. Wr = watts per revolution, which in motors = 746 × b.h.p./revs. per min. C = 387.

We all know that the weight has decreased since the above formula was proposed. The weights, however, for a line of machines designed on the same lines still vary as the two-third power of the Wr.

With present-day machines having cast-iron yokes, the factor C = 190 approximately. For four-pole machines having steel yokes the figure varies from 150 to 170.

In the line of machines having the simplified cast-iron construction, as described, the weight factor is about 175. The curve for weights for a Wr up to 4 was shown in fig. 3.

By introducing one or two of the refinements indicated, and by increasing the ratio of copper to iron, the weight constant can no doubt be reduced to 150 or less, with a very moderate temperature rise.

Although the observations in this article have been mainly confined to machines up to about 6 b.h.p., or a specific output of 4 watts per r.p.m., it must not be thought that this output forms a limitation for this type of magnet structure. It is possible to build, with economy, machines up to many times this output.

Certain modifications may be desirable in the larger outputs. For instance, each of the field coils should be made in two sections. It will be wise to follow this course even in the very small machines of high voltage.

Possibly, too, in the larger machines with two-pole armature windings, a modified form of end winding may be found of service. It is found that with the ordinary barrel winding the armature is not unduly long, as with the big distance between the pole tips in a two-pole design, chord windings can, with great advantage, be used. In several small armatures already made the end windings have only required approximately the same space as in the case of four-pole construction.

When using interpoles it is advisable to advance the armature winding pitch, but not necessarily to the full pitch. It may be mentioned that one interpole only may be used by suitably arranging the main poles so that a larger space for the interpole is provided on one side.

Before concluding, there are a few points to which reference will be made. Instead of fixing a perforated cover on the magnet frame over the ventilating aperture, a plain cover may be used having distance pieces as shown in the fragmentary view (fig. 7). It is possible to keep the ventilating apertures horizontal instead of vertical. The temperature rise even then is not excessive. It would naturally be expected that the temperature rise under this condition would be in excess of that obtained with the vertical openings.

A fan can be used, too, if desired; then, of course, the ventilating apertures could be closed.

A probable application of the type of magnet frame described will be for constant-voltage dynamo construction by what is known as the third-brush method.

It will be seen that the poles can easily be cut away between the two limbs, so that trouble due to parasitic currents could be minimised. For different positions of the third brush, two opposite limbs might easily have wide gaps "cored" in them for a similar purpose.

This magnet system, when fitted with the third brush arrangement, might be utilised for a three-wire system where a small unit is required.

THE BRITISH ASSOCIATION.—IV.

Electrical Ignition Apparatus for Internal-combustion Engines.

By E. O. Turner, D.Sc., A.M.I.E.E. (*Abstract.*)

Section G.—Engineering.

One of the reasons for the increase of interest in magneto design has been the recent introduction of a cobalt-steel alloy from which an energy per unit magnet volume of from three to four times as much as the best hitherto obtainable may be developed; the full effect of this remarkable discovery may not be felt for some years to come.

The method adopted in the paper is first to consider induction coils and the magneto is then treated as a special type of induction coil.

It is the opinion of those who have studied the subject of spark ignition that if a spark actually occurs in an explosive mixture ignition will follow, and however much the spark energy be varied, no variation in the power developed will follow. If the spark fails to ignite the mixture, no increase in the energy of the spark will cause an explosion. Assuming, then, that it is necessary merely to cause a spark without any regard to its character, the requirements to be fulfilled by an ignition generator may be stated as follows: (1) The spark must take place at a cylinder compression, varying, according to the type of engine and the conditions of working, between 30 and 160 lb. per sq. in. The voltage required to break down the gas between these limits of pressure may be taken roughly as being from 5,000 to 25,000 volts. (2) Sparking must be regular between limits of low and high speeds. (3) The functioning of the generator should be as far as possible unaffected by variations in the external circuit. As regards the first condition, it has been demonstrated that in automobile engines the compression at the moment of explosion may be at high speed actually less than half the maximum, or slow speed, compression. With regard to condition (2), it would be better if there were no lower speed limit, but as a magneto must be turned at a certain speed in order to begin sparking, care must be taken that this speed is rather less than at which the engine can be turned by whatever starting method is adopted. The third requirement refers to variations in the external circuit. The two factors which affect the sparking most are the presence of capacity in series with the plug electrodes and the joint resistance of the leakage paths in parallel with them. As a general rule the first may be ignored, but leakage resistance paths may seriously affect the sparking. It is impossible to prevent the formation of a number of these branch circuits. Some of them consist of paths of surface leakage across the insulation, both at the generator and at the plug terminals; others are formed through the body of the plug, and their resistances vary according to the temperature of the plug, the amount of carbon deposited upon it, &c. In comparing ignition generators with other electrical machinery a "figure of merit" is proposed. In the case of induction coils this figure would be obtained by dividing the "utility" (equivalent to the output of other classes of electrical machinery) by the product of the least sparking voltage and the supply current. The figure of merit for a magneto would then be the "utility" divided by the product of the least sparking speed and the magnet energy. This closely resembles the output coefficient of electrical machinery, which may be expressed as output/(least speed of operation × rotor volume). For the contact breakers either platinum-iridium alloy or tungsten may be used. The first has the drawbacks of expense and transfer of metal from positive to negative; the second is comparatively cheap and very hard, but the resistance rises to a high value under certain conditions. The form of contact breaker usually adopted is such that the contacts are opened by means of a cam operating a lever against the pressure of a spring, the latter being relied upon to close the contacts. Extreme care is necessary in design and manufacture to ensure satisfactory operation at the high speeds which are now required in multi-cylinder automobile engines. Some engine makers call for considerable accuracy in the intervals between successive explosions; for example, it may be stipulated that the difference between the actual and theoretical firing angles shall not exceed 1 deg.—measured on the crankshaft. To meet this requirement it is necessary that the opening shall take place comparatively abruptly. This tends to produce "flinging," *i.e.*, a lagging of the lever behind the cam, at very high speeds, which prolongs the "break" period and shortens the "make." This is not important in magnetos, but with coil ignition it is imperative that there should be no "flinging."

Most induction coils are built with only a core of magnetic material, the circuit being completed through an air path. Unless the outer diameter of the coil is small compared with the core length the linkage of flux with the outer layers of the winding will be incomplete. As the object of design is the transference of as much energy as possible from the primary to the secondary circuit, rather than the establishment of a high peak voltage, this partial linkage is to be

avoided as far as possible. For this reason laminated steel cheeks, of a diameter preferably exceeding that of the coil, fitted so as to closely embrace the core, are sometimes added. When these are fitted the field due to the primary is partly screened, and does not stray over so large a space, and the coil is less likely to be influenced by neighbouring masses of metal. Considerable care is required in deciding the number of primary and secondary turns. Under high-speed conditions it will be found that if very few primary turns are employed the m.m.f. and flux will be correspondingly low; if too many are chosen the current will only have risen to a small proportion of its maximum value when it is cut off and the m.m.f. will still be low; there is thus a definite number of turns which will establish the greatest core flux. Since at high speed, that is, with primary current considerably below the maximum, the flux density in the iron will be low, the inductance of the primary winding may be expressed in the form $a\,n^2$, where a is a constant depending solely on the shape of the magnetic circuit. By this means, and the equation for the rise of current in an inductive circuit, the best value for n_1 may be found. At speeds below the maximum, if the iron ampere-turns are appreciable, the inductance is not constant for a given number of turns, and it must, therefore, be expressed in terms of the magnetisation curve of the coil. If the equation for the rise of current is transformed into the form—

$$t = \frac{\Phi_1 n_1}{10^8 R_1 i_1} \log \frac{I_1}{I_1 - i_1}$$

by tabulating assumed values of i_1 the corresponding value of the primary m.m.f. $n_1 i_1$ and the flux Φ may be found and values of t worked out and plotted against i_1. This procedure is necessary, since the magnetisation curve of the coil cannot readily be expressed in the form of an equation.

The number of secondary turns should be as small as is consistent with satisfactory performance at reduced voltage. If more turns are employed than are necessary to establish the breakdown voltage the secondary current flowing in these unnecessary turns will represent a considerable voltage consumption. Tests have been carried out showing that there is a well-defined maximum utility at about 16,000 turns. A very large number of secondary turns ensures a spark being produced at a very low voltage, but only at the expense of the utility.

During the first part of the cycle of spark production the secondary winding may be ignored and the magneto may be considered as an alternator, of which the primary circuit constitutes its armature winding, working on short circuit. As regards the second part of the cycle, the "spark flux" can be expressed in terms of the armature m.m.f. and the

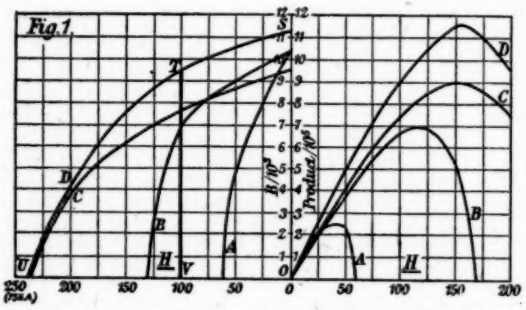

Fig. 1.—Comparison of Various Magnet Steels.

joint permeance of the branch circuits. As soon as the spark flux is found, the problem of the magneto becomes a common one with that of the induction coil. The greatest drawback of the magneto is the inherent weakness of the spark at low-speed, when the utility should be greatest. The best that can be done is to increase the product $i_1 n_1$ at low speed by employing as large a total cross-sectional area as is compatible with leaving room for the secondary winding.

There are a number of drawbacks associated with magnetos, from which, hitherto, there has been no means of escaping. The lamination of the armature core, for example, is necessarily very imperfect. The actual laminations employed form only about a half or less of the total core length, and they are not only supported by large solid-steel cheeks carrying flux but the effective lamination is also reduced by a number of rivets right through the structure, while the necessity for a considerable portion of the flux to cross the remaining laminations transversely is a still further source of loss. Other drawbacks involved, such as rotating windings, rotating contact breakers, and the very large number of carefully insulated parts which form a kind of high-pressure transmission line from armature to plug, reflect more on the reliability of the magneto than on its utility or its figure of merit. The recent introduction, however, of cobalt steel for magnets offers the means of overcoming a number of the difficulties alluded to, and it is likely that in a short while the use of tungsten magnet steel, at all events so far as magnetos are concerned, will be entirely superseded. In fig. 1 are shown portions of the hysteresis loops and also the products of B and H plotted as a function of H for different magnet steels. From this it will be noted that the maximum BH product obtainable from a good tungsten steel magnet, curve A, is about 260,000. The earliest samples of cobalt steel gave a curve similar to B, having a maximum product of about 700,000. To-day curve C, with a product of 900,000, is an average sample, and results as shown in curve D are by no means uncommon. It will be noted that the flux density at which the maximum product occurs is approximately the same both for tungsten and for cobalt steel; thus, to establish a given flux, the same area of cross section is required for both, but whereas the value of H available for the external circuit with the former material is about 35, for the latter it is about 150, so that the cobalt steel magnet need be only about one-quarter of the length of the tungsten steel magnet it replaces. Merely shortening the magnet is of itself no great improvement and would not appreciably affect the utility or the figure of merit of the magneto. The substitution of a much shorter magnet, however, makes other forms of construction possible which do not possess the drawbacks referred to in the rotating armature machine. It is as yet too soon to discuss the various arrangements which recently published patent specifications indicate are in course of development, but there is little doubt that the chief advantages which may be looked for in the near future will consist of a more compact structure, a shorter magnetic circuit, and a more thorough lamination of the armature flux path, ensuring a more efficient use of the magnet energy.

In conclusion, the author acknowledges his indebtedness to the British Lighting & Ignition Co., Ltd., and Messrs. Vickers, Ltd., from whom information was obtained.

Discussion.

Prof. G. W. O. Howe said that although it had been proved that the energy obtainable from an explosion was independent of the nature of the spark used to give that explosion, he was afraid that this fact would be very slow in making headway among motorists. So long as the spark was sufficient to ignite the mixture the energy obtainable from the explosion was the same, and all the elaborate system of blue and white sparks, fat and thin sparks, was largely a myth. The interesting question, he said, was as to what constituted the great superiority of certain brands of magneto. A great deal of research work had been done in this country, and magneto manufacture had been brought to a high state of perfection as a result of the war. Even so, he suspected that even now many English motorists preferred Bosch magnetos. He believed he was right in saying that the world-wide reputation of the Bosch magneto was not due to any difference in principle or in design, but merely to the careful manufacture of small details, which prevented the thousand and one accidents which could happen in a magneto. With regard to the use of cobalt steel, he referred to a magneto exhibited at a recent meeting of the Institution of Electrical Engineers, made with a magnet of cobalt steel, and the difference in size as between magnetos with tungsten and with cobalt steel magnets was striking. He believed, however, that at present it was not an economical proposition to use cobalt steel.

Prof. Sir J. B. Henderson asked for a further explanation of the term "utility." As to the indifference of the power of an internal combustion engine to the method of producing the spark, he expressed the opinion that this was due to the turbulence of the gases. Turbulence was so enormous if the ignition took place during the first compression that two or three sparks made practically no difference to the ignition, but if the piston was allowed to reciprocate several times, and the valves were kept closed several times before igniting, there was an enormous difference, because the turbulence was allowed to die down. He asked Dr. Turner if, in the introduction of induction coils, a closed magnetic circuit had ever been used.

Dr. Turner, in reply, did not accept Prof. Howe's contention that British magnetos were not as good as German. It might have been so in the past, but it was not true now, certainly not in design, because in many ways the British magnetos showed considerable superiority over the German. Undoubtedly the Bosch magneto owed its supremacy chiefly to its excellent workmanship. As to cobalt steel, with magnetos as they had been made in the past it was not a commercial proposition. If we only replaced a horse-shoe magnet by a shorter magnet it was an economic proposition, but other possibilities were opened up, which made it, not only a question of the alteration of the magnet length, but a question of rendering possible other forms of construction in which far more energy might be obtained in the magneto for a given weight than before. In future cobalt steel would be used almost to the exclusion of tungsten steel, provided changes in design of magnetos took place. In reply to Sir J. B. Henderson, he said that the utility merely referred to the conductance in parallel of the plug circuit, and not of the whole. In reply to the question as to the closed magnetic circuit, the question was largely one of rated decay of the flux. If the circuit was closed, as in a transformer, it was found, in the first place, that the flux would decay much more slowly; and secondly, that the flux would not die away to zero. In order to make the flux fall nearly to zero it was

necessary to leave air gaps. He believed that Sir J. B. Henderson had put his finger on a spot where much progress could be looked to in the future. Undoubtedly gaps would have to be left in the circuit in order to ensure efficient demagnetisation.

Fuel Economy Committee's Report. (*Abstract.*)

Section B.—Chemistry.

THE fifth report of the Committee upon Fuel Economy was presented to Section B on September 12th.

The report opened with a reference to the effects of last year's coal dispute upon production, and consequently upon the iron and steel industries.

During the year the Committee had under consideration the question of oil supplies, and particulars were compiled of imports into the United Kingdom for the five years from 1917 to 1921 inclusive. The figures showed that the maximum import of fuel oil occurred in 1918, when the total was 3,515,020 tons. The lowest total was that of 1919—1,105,855 tons; in 1921 the figure was 2,255,822 tons. The bulk of the last year's importation was from Mexico, with the United States second. A total of 85,483 tons came from the British West Indies. The Committee considered that our dependence upon foreign sources of supply was dangerous, and in this connection reported the present state of the low-temperature carbonisation of coal in this country. It referred to the experimental plant at Barugh, near Barnsley*; the conference on the subject held this year at Cardiff under the auspices of the South Wales Institute of Engineers; the paper read in April last by Messrs. Sutcliffe and Evans before the Society of Chemical Industry; and the Fuel Research Board's report, published recently. The Committee was in general agreement with the last-named report that, although we had not yet reached the stage when it could be decided whether or not a new industry could be established to deal with the carbonisation of the coal which was at present being consumed in the raw state, yet, as the result of the pioneering work carried out by various organisations, such knowledge and experience as had been gained afforded some ground for the expectation that we were approaching a conditional solution of the matter. The future seemed to depend upon the acceptance by the public of a smokeless fuel; the price of this should be reasonable and its appearance should be attractive. If such an industry were established the amount of carbonised fuel required for domestic consumption would be at least 40 million tons per annum. The by-products from this quantity of coal would possibly be 100 million gallons (or about 350,000 tons) of motor spirit, and 600 million gallons (2,750,000 tons) of anhydrous tars (fuel oils). Oil-fuel burners for boilers had been considerably improved, and so had the injection of oil in internal combustion engines, making it possible to use successfully the heavier oils. Work in connection with the adaptation of heavy oils to low-compression i.c. engines was now proceeding.

Part III of the report dealt at some length with the progress made in research upon the chemistry of coal.

Part IV treated of the possibilities of developing brown coal and lignite as fuels, but it was recognised that this was of small importance to Great Britain itself, although it was of some moment to several of the Dominions. Some particulars were given of the celebrated Morwell (Victoria) brown coal deposits. It was stated that the official estimate of the cost of producing the raw material was about 2s. 6d. per ton; that the cost of electrical energy generated by its agency would not exceed £2 17s. 6d. per horse-power per annum; and that this energy could be profitably sold at an average price of £4 8s. per horse-power per annum. Prof. Bone, in his investigations into the Morwell brown coal and other deposits, established that there was a definite temperature limit for each type up to which it might be heated (in the dry state) so as to effect a considerable chemical condensation in its cellulosic or humic constituents, with simultaneous expulsion therefrom of steam and CO_2; that by means of such condensation substantially the whole of the potential energy of the fuel might be correspondingly concentrated by suitable heat treatment, and the fuel value would thereby be improved.

The section upon domestic heating and cooking appliances dealt almost exclusively with means of improving the ordinary coal range. The question of the efficiency of gas and electric cookers was deferred as requiring further investigation. In Part VI the Committee called attention to the need for more systematic effort on the part of steam users to improve the present unsatisfactory state of boiler practice throughout the country, especially in the direction of educational provision for the better training of stokers and power-station superintendents. It was averred that if scientific methods were substituted for the present rule-of-thumb methods the average efficiency of steam raising could be improved from the present 60 per cent. to 75 per cent., with consequent saving in fuel. A serious source of waste was said to be the fact that unnecessarily large volumes of air were drawn through the system owing to sheer neglect of the most obvious precautions. With good management it should be possible by careful damper regulation and maintaining a correct depth of fire, to burn completely an average quality of steam coal with no greater excess of air than would give about 12 per cent. of CO_2 (without appreciable quantities of CO) in the chimney gases. While the more general use of indicating and recording apparatus might be recommended as the best automatic aids to good management, yet unless these were supplemented by intelligence and watchfulness on the part of both stokers and boiler-house superintendents, they would not avail much, and might actually be misleading. Large boiler installations should be in the hands of specially-trained technologists. Local educational authorities could help fuel economy by instituting in technical schools properly organised classes of instruction for stokers and the lower grades of boiler-house attendants. In larger centres more advanced courses should be arranged for the higher officials.

The Committee pointed out that the Electricity Commissioners would render a great national service if, in their annual returns, they would publish such financial and detailed technical data as would show the actual fuel consumption and the production cost per unit of output in the various individual power stations throughout the country.

With regard to smoke abatement, the Committee mentioned the report of the Departmental Committee appointed by the Ministry of Health to deal with the subject. Although it was calculated that domestic chimneys were responsible for the discharge into the atmosphere of 2½ million tons of potential fuel in the form of soot, as against 500,000 tons from factory chimneys, it was considered impracticable to introduce legislation to counteract this waste. It was recommended, however, that the central housing authority should have certain supervisory powers with regard to heating methods in housing schemes submitted by local authorities, and that the latter be empowered to make by-laws requiring the provision of smokeless heating apparatus in new buildings other than private dwelling houses. With regard to industrial smoke, it was recommended by the Departmental Committee that the Ministry of Health should be given more definite power to compel local authorities to properly administer the laws dealing with smoke abatement; that a legal obligation should be imposed on all manufacturers to employ the best possible means for avoiding the pollution of the air by grit or smoke; that the same law should apply to Government establishments and to road and rail vehicles; that the Ministry of Health should be empowered to fix smoke standards from time to time; that the administration of the smoke abatement laws should be transferred to county authorities; and that advisory officers should be appointed by the Ministry of Health to assist local authorities and manufacturers in the matter. In conclusion, the Committee gave it as its opinion that the Ministry of Health should institute a Smoke Inspectorate upon the lines of the existing Alkali Inspectorate, which had admittedly worked well and with beneficial results to the industry concerned.

An appendix to the report gave data as to methods of determining the efficiency of cooking appliances. It was stated that the true determination of efficiency could only be made by raising the apparatus to, and maintaining it in a steady state, during which period valid observations on running efficiency could be made. Fairly complete investigations had been made of solid fuel and gas cookers, but the electrical series was still in progress at the date of the report, and could not be spoken of with the same degree of confidence as in the other two cases. Particulars of results only, therefore, included figures obtained with the use of solid fuel and gas appliances.

* ELECTRICAL REVIEW, November 18th, 1921, p. 664.

The Origin of Magnetism.

Section A.—Mathematics and Physics.

IN opening a discussion upon the above subject, Prof. P. WEISS said that Langevin had considered a body each molecule of which had a constant magnetic moment and complete freedom of orientation (a paramagnetic gas or a dilute solution containing a paramagnetic salt). By applying to such a substance the principles of statistical mechanics he had found its law of magnetisation in terms of the external field and the temperature, and had thus explained the paramagnetic phenomena. Van der Waals had explained the great density of liquids on the basis of the kinetic theory by adding to the external pressure an internal pressure which expressed the attraction exerted by the molecules on one another. The speaker had shown, similarly, that the intense magnetisation of ferromagnetic bodies might be deduced from the laws of paramagnetism by adding to the external field a molecular field which represented the mutual actions of the magnetic molecules in relation to orientation. He assumed that the molecular field was proportional to the intensity of magnetisation, and in the same direction. This hypothesis had enabled the variation of the magnetic saturation of ferromagnetic substances to be calculated for the first time as a function of the temperature. The law thus found had been verified by new experiments with magnetite. The same hypothesis had given, in addition, the following results: Above the temperature at which strong magnetism disappeared—or the "Curie point"—the coefficient of magnetisation was inversely proportional to the excess of temperature over the "Curie point." This law was

in accordance with experience. At the "Curie point" the true specific heat of a ferromagnetic substance fell abruptly to a smaller value. The magnitude of the discontinuity calculated from the magnetic data had been found to agree with the value obtained by thermal measurements. The theory of the molecular field permitted us to anticipate a reversible phenomenon, namely, that a substance became hotter when magnetised and cooler when demagnetised. This phenomenon had been observed and found to be in accordance with the theory. By supposing that in a crystal the molecular field had three different values in the directions of three rectangular axes, it had been possible to explain the remarkable anisotropic properties which had been discovered in the crystal of pyrrhotine. The molecular field theory, in conjunction with Langevin's kinetic theory, had provided means of calculating, on the basis of experimental data, a great number of atomic moments. All these moments possessed a remarkable property: they were integral multiples of the same elementary moment which the speaker called the "magneton." But the same atom did not always possess the same number of magnetons. For example, metallic nickel had three magnetons in the neighbourhood of absolute zero. After a region of transition, it held eight magnetons from 500 deg. C. to 900 deg. C. Then at this temperature it passed suddenly into another state with nine magnetons.

In its solid paramagnetic salts, nickel with both 15 and 16 magnetons could be recognised, while in solutions of its salts it had 16 magnetons.

It would be possible to make analogous statements with regard to iron and the other ferromagnetic metals. The discontinuous variability of the atomic moment had been made strikingly evident by the discovery of ferro-cobalt (Fe_2CO), which was more magnetic than iron itself, and possessed 12 magnetons for each of its three atoms, whilst iron and cobalt under the same conditions only had 11 and nine magnetons respectively.

It might be concluded that magnetic atoms were the seats of characteristic moments which varied in a discontinuous manner according to the state of the body, and which were integral multiples of a single definite elementary moment—the magneton. Intense magnetism—or ferromagnetism—was the result of the existence of the mutual orientation effects of the magnetic molecules, which were expressed by the molecular field.

MUNICIPAL TRAMWAYS ASSOCIATION (INC.)—III.

ANNUAL CONFERENCE.

Tramway Rolling Stock.

On September 14th the paper by Mr. E. S. Rayner on "Tramway Rolling Stock," which was abstracted in our issue of September 15th, was read. Opening the discussion,

Mr. R. S. Pilcher (Edinburgh) agreed with Mr. Rayner that it would be beneficial if weights could be reduced. Edinburgh had recently reduced the height of the cars by 6½ inches, whilst the cantilever platform had been dispensed with, and there was a continuous frame from end to end of the car. The appearance of the car was enhanced, and the centre of gravity was lower. A light motor had also been introduced. The weight of the car had been reduced from 11 to 9¼ tons, the carrying capacity had been increased from 54 to 60 per car, and the weight per passenger had been reduced from 456 to 354 lb. The speed had been increased, and the Ministry of Transport had sanctioned 20 miles per hour on certain routes. They had tried roller bearings, but had not so far found any reduction in energy consumption. He understood that ball bearings cost £100 per truck, and for that money manufacturers must be able to show some return in a reduction of costs. The question of renewals was a very important matter—Newcastle had almost absorbed its reserve in meeting charges of that character—and the speaker advocated weight reduction as far as possible, without reducing strength.

Mr. W. M. Milnes (Wigan) said that tests that had been conducted were in every case favourable to ball bearings. In actual working over the last nine months the roller bearings had shown a saving of energy as high as 16 per cent., as compared with other cars, and as low as zero. The average saving of energy on roller bearings was 3.5 per cent. over the period named. There was as yet no sign of wear on the bearings, and the lubricant was clean. The cost of converting a single truck was at present about £175. On a 3.5 per cent. saving of energy it would be a long time before the cost was made up. Wigan, therefore, was going no further in converting cars in its present financial position, but if he were ordering new cars, he would specify ball bearings.

Mr. C. W. Silvers (Wolverhampton) thought more efficient results could be obtained with the chain drive, than with the—in his opinion—merely fashionable worm drive. He advocated a single-deck type of car, with a high centre of gravity, and considered that with trailers attached such a type of car was hard to beat. A great deal of wear on the track was due to grit and mud rather than to car construction.

Mr. C. J. Spencer (London) said that as cheaper fares were desirable, those responsible for the tramways must set about lowering their costs by adopting new methods. He suggested the setting-up of a Research Committee representative of the Association, to meet and confer with manufacturers. Officials of the Tramways and Light Railways Association would always co-operate with such a committee.

Mr. B. Hall (Halifax) advocated a combination of the lightening process with the use of lighter alloys.

Mr. P. Priestley (Liverpool) observed that in his own town they had adopted a heavy track, and he suggested that the question be considered along those lines, instead of lightening the cars.

Alderman T. Corby (Huddersfield) said they had had a very costly experience with a differential gear, and were not inclined to repeat the experiment.

Mr. A. R. Fearnley (Sheffield) contended that the efficiency of the present-day tramcar was considerably higher than that of the motor vehicle. In 21 months' experience of ball bearings, he had found no advantage. He deprecated the suggestion that tramcars were not keeping ahead of the times, and said innumerable improvements had been introduced with regard to details and efficiency.

The President thought the time was not quite ripe for the appointment of the suggested committee, and the matter was left in abeyance until next year's conference.

"Highways" Costs Borne by "Tramways."

By H. Mattinson, A.M.Inst.C.E.,
General Manager, Manchester City Tramways.

(Abstract.)

Under the Tramways Act, 1870, we are:—To provide the "Highway" formation for the width of our tramway and 1 ft. 6 in. beyond; to maintain such "Highway" formation so long as the tramway exists; and to reinstate the roadway, in the event of the tramway being abandoned.

These conditions, imposed when all tramways were horse-hauled, were just and reasonable. It is the introduction of electric traction which has altered the circumstances and which renders a reconsideration of the obligations necessary, and it is the use of this "Highway," provided by the "Tramways," by irresponsible motor 'bus competitors that aggravates the injustice. Our object, therefore, is to claim relief from those obligations that are in common equity and fairness chargeable against highways authorities.

The tramways require a rail, held by tie-bars and supported by an adequate foundation. Generally speaking, a stringer 1 ft. 6 in. in width and 6 in. thick has proved adequate—the rail, packed on this and held by tie-bars, constitutes our "structure." All the rest is "Highways." I consider, therefore, that where the concrete and paving extend in common the full width of the road, the whole cost of such "Highway" construction should be debited against the Highway Authority in so far as it is saved such cost.

In the event of the roadway in question not requiring concrete foundations or paving for the general traffic thereon, it is obvious that, in common fairness, the local authority cannot be charged with the cost of a type of construction called for by the laying of the tramway. If in course of time the local authority should reconstruct the sides of the road, a contribution should then be made towards the cost of the original tramway area based on the cost of such reconstruction.

As regards maintenance, I do not see that we can escape this, nor ought we to attempt to do so. The obligation is ours under Section 25, to keep the surface of the roadway level with the rail, and, furthermore, it must be admitted that we do *disturb* paving more than ordinary traffic even if we do not wear it; also it is to our interest that we do this work, to enable us to maintain our rail in adequate condition. The utmost claim we might fairly make herein is an allowance toward the cost of the work, based on that incurred by the Highways Authority on the adjoining sides of the road, together with any grant from the Ministry of Transport in respect thereof.

References have been made to the amount paid in local rates, in respect of the permanent way, but, so far as I can ascertain the facts, any alteration in the incidence of the charges relating to the repair of the highway would not

materially affect the rates payable by the tramways. The repair and renewal of the paving or any portion thereof has no bearing whatever on the liability of tramway undertakings for payment of rates.

Tramways are, or should be, rated on the rent a hypothetical tenant would pay, and the first factor in arriving at this rent is the gross earnings which arise out of the user of the tramway. The repair and renewal of the tramway is a statutable deduction to be made from the gross estimated rental, and if the liability to repair and renew the paving or any part thereof was taken away from tramway operators, it would appear to follow that the paving would no longer form part of the hereditament for rating purposes, and no such deduction would then arise. In this event the statutable deductions would be reduced by the elimination of the cost of the repair and renewal of the paving, and the net rateable value on which rates are paid would be correspondingly increased.

One could recite instances of the injustices of our highway liabilities indefinitely. In Manchester we have an instance of a reserve line that practically has had no cars over it—probably not 100 all told—yet has been completely worn out and relaid, consequent on the vehicular traffic.

The obligation is a statutory one and only Parliament can modify it. The departmental attitude towards this proposal is, I believe, not at all sympathetic, in which case there would appear to be no alternative but that of a private Bill.

Discussion.

Mr. J. B. Hamilton, C.B.E., general manager of the Leeds Tramways, opened the discussion. He stated that Mr. Mattinson's subject had been dealt with twice previously at other conferences. That, he contended, was an indication of its importance. The whole question had entirely shifted from the time when the Tramways Act was passed, putting the maintenance of the track upon the tramways. The horse cars had gone, and on the other hand there was heavy tractor and vehicle traffic on the roads, which was responsible for a good deal of depreciation. It had been urged in a previous discussion at that conference—and he held rightly—that the tramcar passenger should pay for his ride. In respect of the question of road maintenance they might consider whether or not the passenger was having to pay for the maintenance of something, the cost of which should be borne by the ratepayer generally. What was wanted was a private Bill to bring antiquated laws up-to-date, and he suggested that municipal authorities should be approached and asked to say that road charges should be apportioned to the proper accounts.

Mr. E. Hatton (Newcastle) said he entirely disagreed with Mr. Hamilton's views and contended that if tramway undertakings took up the best street positions they should pay for that privilege.

Alderman W. C. Fenton (Sheffield) expressed astonishment at Mr. Hatton's views, because those remarks were diametrically opposed to Mr. Hatton's earlier plea for cheaper fares. If road charges were properly apportioned, fares could be materially reduced. It was high time a proper adjustment was made.

Mr. E. S. Rayner (Hull) said he supported the view that every road user should pay a fair and proper proportion of the cost of road upkeep. It was a fallacy to state that tramways monopolised the road, since they only used that portion of the road on which they happened to be running. Neither tramways nor ratepayers should be called upon to bear road costs. Tramways should maintain rails and foundations, and obtain a rebate from the roads authorities, the road costs being fairly apportioned to road users. Under such circumstance the penny fares would soon be an accomplished fact.

Alderman T. Hey (Halifax) supported the general opinion expressed in the debate.

Capt. L. C. F. Bellamy (St. Helens) suggested that consideration should be given to the proposals of the Ministry of Transport for payment on a seating basis.

Mr. J. Beckett, general secretary, pointed out the difficulties that arose in relation to privately owned concerns, by reason of the existence of the Road Fund.

A resolution on the lines suggested by Mr. Hamilton was adopted by the conference, the only dissentient being Mr. Hatton.

Traffic Regulation.

At the request of the London County Council, the Conference gave some consideration to the regulation of traffic at tramway stopping places. That body asked for consideration with a view to taking steps to promote legislation to deal with the matter.

Mr. Beckett placed before the Conference certain correspondence that had passed with the Minister of Transport, drawing the attention of the Ministry to the danger to people alighting from tramcars by reason of vehicular traffic passing on the near side of the cars. The Minister had replied that he could not see his way to take any steps in the matter, and drew attention to the provisions of the Motor Car Act. That Act, said Mr. Beckett, was not sufficient to meet the danger. He quoted from a report which stated that more than 25 per cent. of the accidents to persons alighting from or boarding tramcars were caused by horse-drawn vehicles or bicycles.

Councillor G. R. Davey (Ilford) said the necessity for action was patent, and the only reason something had not been done was that the authorities failed to realise the urgency of the question.

Mr. T. B. Goodyer (Croydon) stated he had been in correspondence with the coroners of the country, and they were in favour of some regulation being passed to prevent vehicles passing between the kerb and standing tramcars.

Mr. J. Dalrymple (Glasgow) said there had been a by-law in that city for at least ten years, prohibiting vehicles endangering tramcar passengers alighting or boarding. and it had had beneficial effects. There had been some difficulty in working it at first, indeed, there had been some prosecutions, but now it was fully observed.

Mr. J. Barnard (Bolton) supported the general plea for regulations.

Mr. A. L. C. Fell (London County Council) suggested that the whole matter should be referred to the Executive Council, with a view to action being taken, and this was agreed to.

This ended the business of the second day.

Dinner.

The delegates were entertained to dinner by the Newcastle Transport and Electricity Committee on Thursday, September 14th, Alderman R. Mayne presiding, and in addition to the delegates there were present the Lord Mayor and Lady Mayoress, Sir A. Munro Sutherland, Bart., and many other leading citizens.

Sir A. M. Sutherland proposed the toast of the evening: "The Municipal Tramways Association." He said from small beginnings the Association had risen to great proportions. Now they had £62,000,000 capital. He hoped the members would not shut the doors of their cars to the man who had only a penny. But if they wanted to reduce their fares they must reduce the expenses all round; and if they wanted to increase their income they must reduce their fares. The tramway workers in Newcastle were a splendid body of men, but he failed to see why a man working for a municipality should be paid more than he would get in any other industry. They had to pull together in order to live with the times.

Alderman Mayne, in responding, said it was a day of anniversaries. The Association had reached its majority at the same time as the Hull Corporation tramways had reached the 21st year of municipalisation. During the past two days they had conferred together at one of the best gatherings they had known. Whilst he believed in municipalisation, in practice it raised all sorts of difficulties, and they were feeling those difficulties now. If they thought the municipalisation of public services a sound proposition they must prove it sound. Fortunately, they were seeing their way through. They had pooled their experiences, and learnt from each others' successes and failures.

Mr. Ernest Hatton (of Newcastle) also responded. He said that personally he would rather like to go back to the standard of living in 1914, with the same freedom and cheapness in cost. It was time to reduce working expenses considerably by sound common-sense methods.

The Chairman presented Mr. J. M. McElroy, who had recently retired from the general managership of the Manchester Tramways, and also from the executive council of the Association, with two handsome timepieces, and referred to Mr. McElroy's connection with the Association.

Mr. McElroy, in accepting the gifts, said he had not known a better set of men than those he had met in the work of the Association. They had been tolerant and kindly in all circumstances.

The health of the Chairman was toasted on the proposition of Mr. Dalrymple, of Glasgow.

Report.

The report of the Executive Council shows that the membership comprises 95 local authorities, four honorary members, 96 general managers, and 19 associate members. Seven local authorities are not in membership. Endeavours have been made to induce the Minister of Transport to make permanent the provisions of the Tramways (Temporary Increase of Charges) Act, 1920, and its period has been extended to March 31st, 1924. The Minister has refused to initiate legislation to prevent vehicles from passing stationary tramcars on the near side at stopping-places. Mr. Harry Allcock's proposal that the value of the penny shall be raised to one-tenth of a shilling has been approved by the Council. Attempts to secure the abolition of maximum speed limits have been unsuccessful, but the Minister of Transport has stated that he is willing to authorise speeds up to 20 m.p.h. where the conditions warrant it. The expenditure of the Association for 1921-22 was £3,631, and the receipts were £3,410; the balance sheet shows a surplus of £208.

Returns of the member undertakings for the last financial

year are given in an appendix, from which it appears that the aggregate results is as follows:—

Amount required for renewals at 2d. per car-mile		£2,298,319
Less aggregate amount of surpluses, without any provision for renewals	£1,792,091	
Deduct aggregate amount of deficits ...	334,544	
Net aggregate surpluses		1,457,547
Net aggregate deficits for the year ...		£840,772

The total capital invested was £62,292,756, and the total revenue was £27,222,962.

The total amount charged upon rates was £261,222. Deducting the amount estimated to be contributed to rate aid, £37,465, the net charge was £223,757.

CANADIAN ELECTRICAL NOTES.

The following notes upon developments and conditions in Canada were derived from the September 1st issue of the *Electrical News* (Toronto), a journal which gives very extensive reviews of happenings in the Canadian electrical world.

The coal situation, which is acute in Central Canada, is considered to provide a valuable opportunity for extending the use of electricity. It will have a great moral effect if electricity can demonstrate its value at such a critical time, and dispel, to a great extent, the feeling that electricity in the home is merely a luxury.

One way of spreading the "electrical idea," adopted by at least one Transatlantic undertaking, is house-to-house canvassing. Although decried as being too closely allied to "peddling," many dealers look upon it favourably and consider that if the right kind of man is appointed to do the work the results will be beneficial.

The Murray report criticising the working of the Hydro-Electric Power Commission of Ontario, and the Commission's reply thereto, has once again roused the two camps of those who are in favour of public ownership and those who are not. The Commission asserts that Mr. Murray has distorted figures and inflated estimates of the working costs. The real figure, it appears, is $7,200,000 per annum, whereas Mr. Murray gives a total of $12,310,000—showing a considerable difference. The Commission claims to have justified its very caustic comments upon the report which were issued when the report first appeared.

The contractor-dealers of the Province of Quebec do not intend the recent Act providing for the licensing of contractors and wiremen, and the inspection of installations, to fall into desuetude. They claim that, under the terms of the Act, 60 per cent. of the present *soi-disant* electrical contractors will disappear from the industry. The purpose of the Act is being extensively advertised, and the fruits of this are already beginning to be seen. At least two contracts which were recently awarded to non-licensed contractors have been cancelled, the parties concerned evidently fearing that the underwriters would refuse to grant an inspection certificate, or that the work would be stopped by Government officials.

A description of a "modern electrical home" which was to have been opened in Montreal during the present month indicates it to be a well-organised scheme. The arrangements are in the hands of a large committee divided into sections dealing respectively with finance, illumination, appliances, advertising and publicity, and installation. The organisers include representatives of power companies, manufacturers, contractors, and dealers; the home should prove a great attraction.

An important industry, that of cement production, realises the value of electricity. Recent statistics show that 1,146 electric motors with an aggregate of 60,375 h.p. are working in cement factories throughout the Dominion. One large works has an installation of 14,080 h.p. in motors chiefly of the squirrel-cage type.

The British Columbia Electric Railway Co. is proceeding with the extension of its Stave Lake plant. The existing dam is being raised and a fourth generator of 13,000 h.p. capacity is being installed; this will bring the installed plant up to 52,000 h.p.

The North Canada Power Co. recently issued its first public financial statement, showing a net profit of $84,431 upon a revenue of $344,483, during the year 1921.

The Hydro-Electric Power Commission of Ontario is proceeding with the extension of its lines into rural areas, and eleven more townships are being connected up to the system. The total mileage of transmission lines erected and acquired by the Commission was 3,001 up to October 31st, 1921.

The chief developments in Winnipeg are in the direction of telephones and cooking appliances. The Fort Rouge exchange is expected to be in operation on the automatic system in January next. When this exchange with its 7,000 lines, and the 13,000-line Garry exchange have been converted, two-thirds of the Winnipeg system will be automatic. The Winnipeg Hydro reports that the sale of electric cooking ranges averages 70 a month, and the demand for smaller appliances is exceeding anticipations.

The "broadcasting" fever has firmly taken hold of Canadians. One feature of the National Exhibition at Toronto was a radio section, in which a continuous eight-hour programme of a varied nature was given daily. It is authoritatively stated that in Toronto alone, the number of valve receiving sets in operation is between three and four thousand.

Recent contracts for electrical equipment secured by English firms or their Canadian representatives include an order given by the Ontario Commission to the Ferranti Meter & Transformer Manufacturing Co., for 179 transformers for rural distribution schemes, in sizes of 5, 7½, and 10 kVA; and one placed by the Commission with Messrs. Ferguson, Pailin and Co., for 19 oil circuit-breakers, with a rupturing capacity of 400,000 kVA.

STANDARD BRUSH-HOLDERS.

It was recently decided by a number of electrical manufacturers that the time had come when the standardisation of brush-holders and brush gear would be of great benefit to the industry generally, and, with this end in view, the designers of several of the interested manufacturers met to consider the question.

The advantages to be gained by the users of electrical machinery by such standardisation may be summarised briefly as follows:—

The universal adoption of a standard brush holder will allow the user, even if machines of different manufacture are in his service, to carry only one make of brush-gear spares. Further, the bulk production of a standard holder would enable a considerable reduction in cost to be made.

A list of conditions to be aimed at in designing a standard brush-holder was drawn up, the chief points of which were:—

(1) That each brush-holder should be a self-contained unit and independently renewable, with a view to the ultimate reduction of the quantities of spare parts to be carried.
(2) That the brush-holder should be of the "box" type, suitable for brushes of the dimensions given in the British Standard Specification No. 96.
(3) That the tensioning device should be such that the greatest uniformity of pressure should be maintained throughout the life of the brush, and that independent adjustment of the pressure should be provided for.
(4) That the brush-holder should be readily removable from the carrier.
(5) That all parts should be suitably locked so that there would be no loose parts to become detached.
(6) That means should be provided for accurate alignment of the brush gear, and adjustment for any wear of the commutator.

Simplicity of construction was considered an essential feature, and after examining a number of designs the brush-holder described below was evolved as fulfilling most completely the requirements stated and, at the same time, being suitable for quantity production.

Fig. 1.—The "Standard" Brush-holder.

The brush-holder carriers are of special triangular-section drawn steel, simply cut off to the length required and necessitating no further machining apart from drilling.

Insulation of the carriers from the bracket is of the simplest possible form, and consists of a suitable insulating sleeve moulded round one end of the carrier and projecting beyond the clamp for a sufficient distance on each side to provide ample creepage surface. The carrier is clamped in the machined jaws of the brush bracket by means of a simple cover plate and two or four screws, compensation for any wear of the commutator being provided for by suitable packing pieces under the brush carrier.

The triangular section of the brush carrier ensures that, when clamped up in the brush bracket, it presses hard against one side of the accurately machined jaw, thus en

suring its exact pitch and alignment. Also the brush-holder boxes themselves are pulled up against one side of the brush carrier by means of the clamping screws, which are set at an angle for the purpose.

The method of attaching the brush-holders to the carrier is such that any holder in a line may be removed when desired without disturbing the remainder, and when replaced it will be accurately located so that the angle which it makes with the commutator surface will be the same as previously, and consequently the brushes will not require rebedding.

A substantial terminal or binding post is provided to which the brush pigtail may be attached, and is so arranged that the current is carried direct from the pigtail terminal through the binding post into the brush carrier, so that by this means efficient contact is made whether the surface of the carrier is clean or not. Should it be thought desirable on heavy-current machines, &c., a copper strip can be clamped between the carrier and the brush-holders, the end of the copper strip being arranged to form a brush carrier terminal and thus conduct the current from the brush-holders without its passing through the steel carrier.

The method of constructing the brush-holders produces a substantial box which is capable of standing up under the severe vibration which is sometimes present, and in addition to mechanical strength, extreme accuracy of brush-box dimensions is ensured.

The springs are of the "clock" type, made of phosphor bronze, so that they are free from liability to rust. It is a well-known fact that the clock spring, extended and arched to form a pressure finger, gives the most uniform pressure of any known form throughout the life of a brush. In addition to this advantage the resiliency is greater and the weight of finger less than that obtained with any other form. Adjustment of tension is easily accomplished with one hand by moving the adjusting lever into a different notch in the holder.

The metal at the back portion of the holder is brought round the spring to form a shroud and completely enclose it. This is done with the object of protecting the vital part from damage by flash-over.

The design of the mechanism is such that it can readily be dismantled, and springs or other parts can be replaced in a short time. In addition to this advantage, the gear is locked in a simple and efficient manner, so that parts cannot shake loose while the machine is in operation.

Arrangements have been made to manufacture the "Standard" brush-holder in bulk quantities, so that prompt deliveries from stock can be secured. It is stated that the prices for the large range of sizes turned out are very reasonable, and compare favourably with the prices of any other type of brush-holder on the market.

The patents for this brush-holder are held by the Standard Carbon Brush Holder Co., Ltd., London, to which all inquiries as to sizes, prices, &c., should be addressed.

THE GAS TURBINE.

A New Design.

Since the end of the war experimental work on the gas turbine has again been taken up in Germany, and according to the accounts which have been published in the Continental technical Press substantial headway has been made. It is rather surprising to find that so little interest is taken in the subject in Great Britain, and that the problem is so generally regarded as a hopeless one.

Mr. W. A. D. Forbes gives a brief elementary account in the *Motor Ship*, from which the following details are abstracted, of what has already been done, and indicates a proposed new line of development which is based upon a new theory of nozzle action, and involves the use of a novel type of pump known as a "kinetic compressor."

To become a commercial success it will not be essential that the gas turbine should have an efficiency superior to the Diesel engine, but it will be necessary to obtain an efficiency greater than that of the steam turbine, while, in addition, there should be considerable gains in weight and space.

The gas turbine consists essentially of:—

(1) A combustion chamber in which heat is given to the working fluid.
(2) Mechanism from which useful work is obtained by the expansion of the working fluid.
(3) A cooler in which heat is abstracted from the working fluid; frequently the atmosphere is allowed to act as the cooler.
(4) A pump which compresses the working fluid from the cooler pressure to the combustion chamber pressure, as it is necessary that there should exist a pressure difference between these two components.

The combustion may take place at a super-atmospheric pressure, while the cooler is at atmospheric pressure, or the combustion chamber may be kept at atmospheric pressure while the cooler is maintained at a sub-atmospheric pressure. The latter case is known as a sub-atmospheric cycle, and the pump will have to act as an exhauster unless the vacuum is maintained by other means. The work done by the expansion of the working fluid from the combustion chamber pressure to the cooler pressure is known as the "positive work," while the work absorbed by the pump is known as the "negative work" of the cycle.

The gas turbine may be operated upon three different types of cycle. Heat may be taken in at constant pressure, or at constant volume, or under thermodynamic conditions which vary between these states. Gas turbines have actually been built and operated on each of these three cycles.

In the constant-pressure cycle fuel is burned in a combustion chamber under steady conditions, and the p.v. diagram of the cycle is similar to that used in the Diesel engine, except that in the latter the toe of the diagram is cut off, as the reciprocating mechanism is not suitable for utilising large specific volumes. This type of turbine is divided into two classes: (*a*) Single-fluid turbines, in which the working substance is air; and (*b*) mixed-fluid turbines, in which the working substance is air and steam.

The constant-volume cycle is analogous to the Otto cycle, except that the toe of the diagram is utilised. The unburnt charge enters the combustion chamber, the exit from which is closed by a valve which remains shut until the explosion pressure reaches its maximum value; it then opens, and the pressure in the combustion chamber falls as the products of combustion are discharged through nozzles on to the turbine wheels.

The expansion curve of either type of cycle is usually adiabatic or a close approximation thereto. The compression curve may (in theory) be either isothermal or adiabatic, but in practice, in order to obtain a high overall efficiency, it is necessary to approximate as far as possible to isothermal conditions, and thus reduce the negative work of the cycle.

The constant volume cycle may be operated without pre-compression, but, as is the case with piston engines, an increased efficiency is obtained by first compressing the charge.

In the proposed new Hepburn-Forbes system of operation the sub-atmospheric, single-fluid constant-pressure cycle has been adopted, as it is considered that this type of cycle yields the most promising line of development. Attention has been directed towards the utilisation of the kinetic energy remaining in the gases after leaving the moving turbine blades. To attain this end, the gases on leaving the turbine are passed through a cooler, as far as possible without substantial reduction in velocity, and then into a "kinetic compressor," in which their velocity energy is converted into pressure energy. This new type of compressor displaces the mechanically-driven rotary compressor generally used for maintaining the vacuum, which has, therefore, to be produced by other means. The vacuum throughout the system is maintained by the expansion, through a nozzle system, of high-pressure operating air, in which fuel has been burned, thus enabling a further supply of air, in which fuel has been burned at atmospheric pressure, to be induced to pass through the turbine and do work. Both supplies of air then pass through the cooler and kinetic compressor, and are discharged at atmospheric pressure. The supply of high-pressure operating air is maintained by a separate mechanically-driven compressor, and can induce from four to five times its own weight of air to expand down from atmospheric pressure to the vacuum pressure, and pass through the turbine. The whole mechanism is exceedingly simple, as, apart from the auxiliaries, the only moving parts are the turbine wheels.

Operating on the Hepburn-Forbes system, the calculations in which reasonable allowances have been made for losses, show that an overall efficiency approximating to that of the Diesel engine should be obtained, and there is, therefore, a wide margin for unforeseen contingencies between this value and the efficiency of the very best steam turbine.

THE CORROSION RESEARCH COMMITTEE.

Summary of Sixth Report.

The sixth report of the Corrosion Research Committee of the Institute of Metals on the nature of corrosive action and the function of colloids in corrosion, a summary of which was presented by Messrs. Guy D. Bengough, D.Sc., and J. M. Stuart, M.A., at the annual autumn meeting of the Institute, held in Swansea on September 20th, 1922, attempts to present a general discussion of corrosion phenomena, based on the study of several different metals, and to examine how far the electrochemical theory of corrosion (usually called the electrolytic theory) can account for the observed phenomena. The difficulties encountered by this theory are indicated, and it is shown that it gives a satisfactory account of the facts only under certain conditions, while many facts can only be explained by recognising the important part played by colloids in corrosion. A theory of the mechanism of colloid action is put forward, and some experimental results are reviewed in the light of this theory. Corrosion is defined in its widest sense as the oxidation of a substance which may be produced by chemical or electrochemical means. Chemical reactions

may occur when the reacting bodies are in contact: electrochemical reactions when the reacting bodies are spatially separated. In the latter case the reacting substances must be capable of ionisation, and a portion of the energy of the system appears as electrical energy. Two cases of corrosion are considered, both of which can be carried out chemically or electrochemically. Pure electrochemical action may in certain cases be relatively unimportant. Thus the cathode of a cell of high voltage may be more rapidly attacked than the anode, while an anode at a high voltage tending to force it into solution may be very little corroded, owing to scale formation.

Further facts which are difficult to explain on a purely electrochemical theory are the following:—

1. Certain depolarisers do not increase corrosion, but actually inhibit it.
2. The conductivity of electrolytes is not directly connected with the amount of corrosion.
3. Lambert's pure iron (probably the purest metal ever produced) was found to be readily attacked by sodium chloride solution and dilute acids.
4. According to the electrochemical theory the presence of ions of the corroding metal should decrease the corrosion of most of the common metals. There are, however, numerous exceptions, and in some cases the presence of such ions actually increases corrosion.

The order of corrodibility of metals in distilled water, certain salt solutions, and non-electrolytes, is different from their order in the electrochemical list, which suggests that there are factors interfering with the electrochemical action. Such a factor is scale formation, and a main factor in determining the amount of corrosion by water and salt solutions is the nature and distribution of the products of corrosion. This may be far more important than any hypothetical distribution of cathodes and anodes in the metal.

The effects of strain and impurity in the metal are considered from the electrochemical view to be of fundamental importance, and Lambert's pure iron and lead were prepared with a view to eliminating both these factors. Neither metal was incorrodible in certain conditions. However, potential differences between strained and unstrained portions of the same metal are usually very small, and unstrained (annealed) metal may corrode more rapidly than strained metal; in fact, the effect of strain is a minor and ephemeral factor in corrosion in neutral solutions.

As regards the effect of impurities on the corrosion of metals, a trace of impurity appears to assist local corrosion, but the amount of corrosion is not proportional to the amount of impurity. Even the presence of graphite does not appreciably stimulate the rate of corrosion of iron. The effect of a trace of impurity is probably a trigger action.

Local action at metallic surfaces may be produced in a variety of ways at any selected points by modifying the conditions external to the surfaces, and is not mainly determined by the presence of anodic areas on the metal. Minute pores in a metal may, however, give rise to local action, as has been shown by Seligman and Williams.

The electrochemical theory considers that the action of oxygen is that of a depolariser. It can be shown, however, that atmospheric oxygen has very little depolarising power at ordinary temperatures. The main function of oxygen in corrosion is to oxidise directly the metal, and also in some cases the products of corrosion.

A theory is developed regarding the part played by colloids in corrosion, which may be briefly outlined as follows:—

A metal immersed in water sends positively-charged metal ions into the liquid, and becomes itself negatively charged. In the case of ordinary commercial metals the metal also becomes superficially oxidised if dissolved oxygen is present. The hydroxide produced by this oxidation can take up the ions given off by the metal, and the hydroxide thereby passes into the state of a positively-charged colloid. Some of this colloid will diffuse away, permitting further reaction between the oxygen and the metal surface, and thereby reforming the hydroxide film over the latter. Oxidation is then stopped till this hydroxide can pass into the colloidal state by acquiring positively-charged metal ions. This, in general, does not take place till the colloid initially formed has diffused into the presence of the electrolyte, when it is precipitated by the anion of the dissolved salt, the anion neutralising the charge on the metal corresponding to that on the colloid. This allows the metal to send more ions into solution, and the uncharged hydroxide thereby acquires a charge. If the colloid so produced can diffuse away the process can continue and corrosion develop.

For steady corrosion, therefore, the colloid must be produced under conditions which allow it to diffuse some distance from the metal before precipitation. If it precipitates directly on the corroding surface it will, in general, adhere to the latter and stop corrosion. In the case of a corrosion pit the first condition is fulfilled, since no precipitation occurs inside the pit. It is only when the colloid diffuses through an aperture (generally very small) in the gel-deposits at the mouth of the pit, that it meets electrolyte and is then precipitated. Such precipitation merely thickens the external gel-deposits. These gel-deposits adhere directly to and protect the metal surrounding the pit, and thereby emphasise the local nature of the corrosion.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

Report of Committee.

The report for the year 1921-22 of the Privy Council Committee for Scientific and Industrial Research was recently published.*

As mentioned in a leaderette in our last issue, the need for economy has curtailed the Committee's activities, but nevertheless much useful work was carried out.

The report states that the expenditure of the National Physical Laboratory has now been adjusted to normal conditions, and during the year under review amounted to £190,024. Of this £92,963 was recovered in fees from outside sources and contributions from the fighting services. The expenditure upon the Fuel Research Station amounted to £43,266; this was partly offset by receipts of £1,883 from the sale of by-products. The Low Temperature Research Station, which the Committee's grants have enabled the University of Cambridge to erect and equip for the work of the Food Investigation Board, has been completed. The Board's expenditure during the year was £17,750. The co-ordinating boards and committees, referred to in the previous report, have made steady progress; their expenditure was £21,464, plus £5,381 incurred for work done for them at the N.P.L. The Department has carried out work on nine other research programmes during 1921-22, involving an expenditure of £5,988.

The number of industrial research associations licensed by the Board of Trade is now 24, and 22 of these are in actual operation. Grants to these bodies during the year absorbed £86,355. The balance of the "million fund" remaining unexpended was £816,850. Part of this will be devoted to grants to those industrial research associations already established, while further grants will be made to new associations as they are formed. The balances of other funds held in trust for the Department's use totalled about £7,375. Scientific investigations by other bodies were aided to the extent of £8,287; a list of these given in an appendix shows that grants were made, *inter alia*, for research upon domestic heating, scientific instruments, and low-temperature carbonisation. Allowances were made to 205 students for training in research work; to 55 research workers to undertake independent research or to act as assistants; and 20 grants were made to scientific workers to enable them to employ assistants or purchase equipment. These grants amounted to £47,005 (estimated). Headquarters administration cost £37,560, making the total expenditure for the year £525,585, which was provided from the following sources: Exchequer, £273,194; interest upon million fund, £65,358; from the capital of the fund, £86,355; and from fees from outside bodies, £100,678. Engineer Vice-Admiral Sir George Goodwin, K.C.B., and Dr. J. C. Irvine, C.B.E., have been appointed to the committee in the place of Sir Charles Parsons, K.C.B., and Prof. J. F. Thorpe, C.B.E.

The first part of the report of the Advisory Council is devoted to a survey of activities which was made in order to ascertain whether any part of the work could be curtailed as a measure of economy. The result was a negative one, proving that the Department must be regarded as a national asset, although the value of its work cannot possibly be accurately gauged. As the Council justly states:—"The cost of supporting research cannot indeed be justified by comparing it with the prime cost of production—especially when demands are falling off—but by the consideration that it is the means of improving and cheapening production and, in consequence, of increasing the demand. Research . . . . is a cost of the same category as insurance. It is an insurance against the effects of ignorance with the certainty, if it is wisely undertaken, of large and continuous bonuses."

The British Portland Cement Research Association has by research improvements devised means of reducing the coal consumption in rotary kilns by 4 or 5 per cent. The Scientific Instruments Research Association has produced a rouge and an abrasive of very superior qualities for preparing lenses, prisms, &c. Much conservation of effort has been effected by the co-operation of bodies working upon allied researches, and a number of examples are given in the report, *e.g.*, the British Scientific Instruments, and the Electrical and Allied Research Associations.

The Engineering Research Board suffered the loss of Sir Charles Parsons, its chairman, who was compelled by pressure of other duties to resign. Sir Joseph Petavel, K.B.E., Director of the N.P.L., has been appointed in his stead. Sir John Dewrance, K.B.E., and Mr. S. B. Donkin have joined the Board.

The work of the Physics Co-ordinating Research Board has included position finding by wireless, and the X-ray examination of materials. Among the researches which have occupied the attention of the Chemistry Co-ordinating Research Board is the improvement of accumulators. The Radio Research Board has investigated the laws of the propagation, &c., of electro-magnetic waves, atmospherics, and direction finding. A paper embodying the results of the last investigation is to be read before the Institution of Electrical Engineers during the present session. The National Physical Laboratory has carried out work on standards of measurement, on wireless problems, and in many other directions. The Fuel Research Board's work is reviewed in the report, indicating how valuable it is in making the most of our natural resources,

* H.M. Stationery Office, price 3s. net. (Cmd. 1735.)

by low-temperature carbonisation, steaming coal in vertical gas retorts, pulverisation, and other methods. The Committee on Gauging River and Tidal Currents has done a little preliminary work, including the study of various types of current meters.

The remainder of the report gives details of works published by the Department, particulars of grants to various research bodies and to individuals, and regulations regarding patents dealt with by Government departments.

The appendixes contain details of *personnel*, statistics of grants, a list of aided researches, a list of publications by individuals in receipt of grants, the position of research organisation in the oversea dominions, &c.

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEPTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

24,492. "Variable condensers for wireless telegraphy, &c." U. Beaton and W. Gummer. September 9th.

24,504. "Thermionic valves, attachments thereto, and valve holders." N. Lea and Radio Communication Co., Ltd., and J. Ree. September 9th.

24,505. "Calibration of electrical apparatus." N. Lea and Radio Communication Co., Ltd. September 9th.

24,506. "Motor-car head lights, &c." T. Hunter. September 11th.

24,515. "Electric heaters, cookers, &c." J. Krauer. September 11th.

24,516. "Electric plug and socket connectors." E. E. Bramall. September 11th.

24,519. "Magnetic or electro-magnetic separating devices." H. G. Richardson. September 11th.

24,520. "Magnetic or electro-magnetic separating devices." H. G. Richardson. September 11th.

24,537. "Automatic electric switch." R. Marr. September 11th.

24,570. "Masking device for telephone receivers." G. Black. September 11th.

24,589. "Electrically-operated vehicles." Metropolitan-Vickers Electrical Co., Ltd. September 11th. (United States, September 23rd, 1921.)

24,597. "Electric controlling devices." Sullivan Machinery Co. September 11th. (United States, November 25th, 1921.)

24,614. "Combined lamps and current generators therefor." O. Pletscher. September 11th. (Switzerland, September 11th, 1921.)

24,619. "Electrically-driven periodically-moving mechanisms." C. D. J. Jamin. September 11th. (Holland, October 4th, 1921.)

24,622. "Thermionic valves, &c." W. J. Polyblank. September 11th.

24,633. "Electric rectifiers and methods of operating same." G. Holst and Naamlooze Vennootschap Philips Gloeilampen Fabrieken. September 11th.

24,636. "Thermo electric contact." W. E. Beabey. September 12th.

24,661. "Audible signalling device." C. Baxter and J. Mellor. September 12th.

24,680. "Wireless tuning-coil holder with series-parallel device." H. J. Pugh. September 12th.

24,686. "Wireless apparatus." H. V. Andrew and G. Betjemann & Sons, Ltd. September 12th.

24,706. "Sparking plugs." A. H. Price. September 12th.

24,713. "Electric time switches." C. B. Pinkerton. September 12th.

24,719. "Electric light fittings." M. J. Railing and F. Winstanley. September 12th.

24,722. "Telephone receivers." M. R. Lawrence and Sterling Telephone and Electric Co., Ltd. September 12th.

24,724. "Colliery trams, &c." D. Llewellyn, H. Rees, and S. Rees. September 12th.

24,726. "Power-generating systems." B. W. H. Pratt. September 12th.

24,769. "Safety device for street-car trolley poles, &c." J. King. September 13th.

24,772. "Magnetiser for permanent magnets." Stentophone Motor Accessories (1921), Ltd. September 13th.

24,776. "Electric accumulators." E. W. Teale and W. Whitehead. September 13th.

24,777. "Piano, &c., electric lamps." H. Bray and A. D. Keay. September 13th.

24,778. "Magnetic clutches." C. F. Shanks. September 13th.

24,783. "Rectifying devices, &c." A. R. Angus. September 13th.

24,809. "Electric alarms." L. J. Dabos. September 13th. (France, September 14th, 1921.)

24,810. "Electric ignition devices for liquid-fuel furnaces." W. A. White. September 13th.

24,821. "Locking devices for electrical apparatus, &c." British Thomson-Houston Co., Ltd., and J. Sugden. September 13th.

24,823. "Alternating-current dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). September 13th.

24,828. "Dynamo-electric machines." W. D. Horsley, Sir C. A. Parsons, and J. Rosen. September 13th.

24,837. "Apparatus for electrically heating liquids." D. Thomson. September 13th.

24,839. "Track signals for tramways." J. V. Payne. September 13th.

24,869. "Thermionic valves, &c., for wireless signalling, &c., installations." W. T. B. Roberts. September 14th.

24,883. "Incandescent vapour lamps." A. G. Weieter. September 14th.

24,884. "Electric lighting sets." C. C. Garrard, A. H. Railing, and W. Wilson. September 14th.

24,908. "Electrolytic anti-corrosion systems." A. S. Gush. September 14th.

24,910. "Variable electric condensers." H. Jackson. September 14th.

24,915. "Electric fuses." W. Clark. September 14th.

24,921. "Field magnet frames for dynamo-electric machines." J. Thum. September 14th. (Switzerland, October 22nd, 1921.)

24,948. "Vacuum tube devices." Siemens & Halske Akt. Ges. September 14th.

24,952. "Electrodes for electric arc welding." G. Motte. September 14th.

24,972. "Automatic, &c., telephone systems." D. A. Christian and Siemens Bros. & Co., Ltd. September 15th.

24,998. "Manufacture of grid resistances." L. Satchwell. September 15th.

24,999. "Electricity meters for alternating currents." W. G. Dewsbury, E. W. Jones, Russell Electrical Appliances Co., Ltd., and L. T. C. Russell. September 15th.

25,024. "Transmitters for hand signalling." W. Prior and C. E. Riley. September 15th.

25,027. "Aerial for wireless apparatus." H. W. Parker. September 15th.

25,029. "Electric water heater." W. Colebrook. September 15th.

25,035. "Sparking plug." G. F. Sleath and M. S. Stevenson. September 15th.

25,040. "Telephone ear-pieces." D. Mackenzie. September 15th.

25,041. "Electric insulators." D. Mackenzie. September 15th.

25,042. "Signalling systems." Western Electric Co., Ltd. September 15th. (United States, September 20th, 1921.)

25,051. "High-frequency signalling systems." British Thomson-Houston Co., Ltd. September 15th. (United States, September 17th, 1921.)

25,052. "High-frequency signalling systems." British Thomson-Houston Co., Ltd. September 15th. (United States, September 17th, 1921.)

25,053. "Sparking plugs." A. Bicheno and L. Bicheno. September 15th.

25,063. "Apparatus for regulating electric generators." J. Thum. September 15th. (Switzerland, October 22nd, 1921.)

25,073. "Head lamps for motor vehicles, &c." F. Charle. September 16th.

25,078. "Apparatus for automatically operating electric switches of pumps." E. W. Buckley and Mather & Platt, Ltd. September 16th.

25,102. "Rectifying devices." A. R. Angus. September 16th.

25,105. "Electrically-heated kettles, &c." A. Hague and Hague and MacKenzie, Ltd. September 16th.

25,107. "Electric gramophones." A. B. Campbell and R. D. Fleming. September 16th.

25,114. "Electric switches." F. N. Linstow, J. Mirrey, and A. Reyrolle and Co., Ltd. September 16th.

25,123. "Electric control systems." British Thomson-Houston Co., Ltd., R. D. Given, and W. C. Hiddiard. September 16th.

25,141. "Electric apparatus for recording and reproducing sound." A. F. Sykes. September 16th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

5,456. "Wireless and other signalling systems, particularly for the limiting of signals." J. Scott-Taggart and Radio Communication Co., Ltd. February 17th, 1921. (185,133.)

6,011. "Electric furnaces." A. F. Reid. February 22nd, 1921. (185,136.)

9,024. "Manufacture of storage batteries." H. Wade (Hazelett Storage Battery Co.). March 23rd, 1921. (185,148.)

9,494. "Storage batteries." H. E. Smith. March 31st, 1920. (160,821.)

11,706. "Lamps for road vehicles and the like." Naamlooze Vennootschap Philips Gloeilampen Fabrieken. May 1st, 1920.

13,932. "Tell-tale indicator for electric circuits." J. Atkins and A. S. Powell. May 18th, 1921. (185,165.)

14,063. "Amplifying systems employing electron discharge devices." British Thomson-Houston Co., Ltd. (General Electric Co.). May 19th, 1921. (185,167.)

14,135. "Anchoring clamp for overhead electric lines." I. Prinetti. May 20th, 1921. (185,168.)

14,252. "Means for producing a perforated tape by electric current impulses." C. J. J. Rosendahl. May 21st, 1921. (185,170.)

14,330. "Electric coding machine." E. H. Hebern. May 23rd, 1921. (185,171.)

14,453. "Wireless signalling systems." British Thomson-Houston Co., Ltd. (General Electric Co.). May 24th, 1921. (185,178.)

14,518. "Standardised and interchangeable component parts for construction of wireless apparatus." G. H. Moody. May 25th, 1921. (185,180.)

14,778. "Ignition magnetos for internal-combustion engines." British Lighting and Ignition Co., Ltd., and E. O. Turner. May 27th, 1921. (185,192.)

14,801. "Windings of alternating-current dynamo-electric machines." British Thomson-Houston Co., Ltd., and H. W. Taylor. May 27th, 1921. (185,195.)

14,849. "Electrical connections or couplings." O. T. Banks. May 28th, 1921. (185,200.)

15,447. "Electric arc lamps." R. Rigby. June 3rd, 1921. (185,232.)

15,503. "Cable clamps." C. W. Kemper and J. T. Kemper. June 4th, 1921. (185,235.)

16,036. "Liquid electric motor starter." R. F. Baerlocher. June 10th, 1921. (185,243.)

16,718. "Electron discharge apparatus." British Thomson-Houston Co., Ltd. (General Electric Co.). June 17th, 1921. (185,252.)

17,585. "Electro magnets." J. Neale and J. A. Manners Smith. June 28th, 1921. (185,265.)

17,618. "Electric bell." E. Magerle. June 28th, 1920. (165,730.)

17,785. "Electrically-operated switches and the like." L. H. Wadsworth. June 30th, 1921. (185,267.)

17,936. "Dynamo-electric machines." T. S. Jones. July 1st, 1921. (185,269.)

17,998. "Electrical switchgear." C. W. Kay and Callender's Cable and Construction Co., Ltd. July 2nd, 1921. (185,271.)

18,701. "Electro magnets." H. R. Jones, C. E. Wood, and W. E. Lawton. July 11th, 1921. (185,280.)

18,738. "Metallic vapour lamp." Dr. P. Eversheim. July 10th, 1920. (166,144.)

18,755. "Electric bell or light press switches." J. H. Gath. July 12th, 1921. (185,281.)

19,067. "Electric massage and heating apparatus." K. Horiguchi. July 14th, 1921. (185,284.)

19,433. "Electric relays." Metropolitan-Vickers Electrical Co., Ltd. August 6th, 1920. (167,468.)

19,637. "Electric switch boxes." A. L. Davis. July 21st, 1921. (185,289.)

19,908. "Sound transmitters." F. A. Watkins. July 25th, 1921. (185,294.)

20,096. "'Ironclad' electrical switches." Midland Electric Manufacturing Co., Ltd., and W. L. Barber. July 27th, 1921. (Cognate application 26,852/21.) (185,299.)

20,271. "Electric heating devices." H. J. W. Hamers, M. Buiskool, and W. J. Silman. July 28th, 1921. (185,300.)

20,689. "Electro magnetic switches." British Thomson-Houston Co., Ltd. (General Electric Co.). August 3rd, 1921. (185,305.)

20,720. "Method of attaching or fastening pieces of old tramway or other rails to act as anchors to existing or new tramway rails and the like." H. W. A. Brown. August 4th, 1921. (185,306.)

21,872. "Electrical precipitation." Lodge Fume Co., Ltd. (International Precipitation Co.). August 17th, 1921. (185,315.)

25,896. "Collectors or commutators for electric dynamos and the like." H. Herrmann. November 5th, 1920. (Addition to 159,848.) (171,083.))

25,921. "Rotary electric switches." G. J. Sutton. September 30th, 1921. (185,338.)

26,780. "Electrical entertainment devices." C. Dinnebier. October 9th, 1920. (170,010.)

29,117. "Electric furnaces." I. J. Moltke Hansen. November 3rd, 1920. (171,096.)

34,170. "Storage batteries." Soc. de l'Accumulateur Tudor. December 18th, 1920. (172,989.)

1922.

858. "Dynamo-electric generators." R. Bosch Akt. Ges. February 14th, 1921. (175,607.)

4,334. "Electric switches." Metropolitan-Vickers Electrical Co., Ltd. February 26th, 1921. (175,969.)

6,827. "Waterproof electric blasting cap." A. L. Oliver. March 8th, 1922. (185,370).

8,371. "Lock for electrically-operated lifts." H. F. Thomas and G. Newbury. March 22nd, 1922. (185,372.)